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Journal of Applied Microscopy

VOLUME III

JANUARY TO DECEMBER
1900

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The American Society of Naturalists.

The 18th annual meeting of the American Society of Naturalists met at New Haven, Conn., December 27th, 28th, and 29th. Several other scientific societies met at the same time, and in all there were between 400 and 500 members assembled. The sessions of the American Naturalists opened on Wednesday morning with the different sections in separate meetings. The American Morphological Society met in the Peabody Museum, Prof. Conklin of the University of Pennsylvania being chairman. The announcement was first made of the action taken by the Western members of the association, in forming at this time a Western branch of the American Morphological Society. This organization held its first meeting in Chicago during the last week of December, and is regularly accepted as a Western branch of the organization. While regretting the act of separation, the need for such a step is apparent when the meetings are held so uniformly in the East.

DR. C. S. MINOT gave a paper on "The Development and Morphology of the Vertebral Column." It was most interesting. He showed that in the pig and rabbit there is cartilagenous continuity at first, the whole axis being an unsegmented rod and rising by a series of cornifications; this rod the author designates as the chondrostyle. By increase in size the chondro-cranium arises, the disappearance of the muscular segments in the head region causing the enlargement. Later a segmentation of this primitive rod appears and the final ossification takes place from centers having no morphological significance; these centers are for histogenic convenience purely.

DR. PARKER reported an interesting study on the relation between the number of mammary glands in the pig and the number of young born at any one time, also a comparison between the number of glands present in the two sexes. There was apparently no relation between the number of glands and the number of young, but the average gives more glands than young.

F. B. SUMNER, in his paper on the "The Fish Gastrula and its Modifications," gave an interesting suggestion in regard to the much disputed Kupffer's vesicle. In the catfish and trout this structure was found to be connected with the exterior and hence suggested as being an embryonic nutritive organ.

DR. DEAN, in his "Embryology and Phylogeny of Chimera," advocated their relations as the ancestors of sharks.

DR. BRISTOL and F. W. CARPENTER reported on the "Occurrence of Amphioxus at Bermuda," an interesting and valuable discovery.

DR. C. J. HERRICK discussed the "Trigemino-facial ganglionic complex in Gadus and Amiurus." The plan of his work is to reduce the nerves in these to a type form applicable to the Icthyopsida in general and have it agree with the work already done on Siluroids.

PROF. M. A. WILCOX reported some observations on Acmea testudinalis. The form was collected on the New England coast and showed some marked characters. A strong current is maintained by the action of cilia on the mantle, which has on its edge many unicellular glands. The margin is also set with hollow tentacles which are refracted not by infolding, but by shortening.

DR. MORGAN gave the results of some interesting experiments in regard to the "Effects of Strychnine on the Unfertilized Eggs of the Sea Urchin," showing that development can be caused to proceed to a certain cleavage stage by the stimulus of the drug, but no larva results.

The Association of Physiologists met in the Sheffield Biological Hall or in the Medical School. Prof. Chittenden of Yale was chairman, and a most successful meeting was held. Among many interesting papers only a few can be mentioned.

DR. W. T. PORTER had an exhibition of apparatus for laboratory work, which was especially helpful. The apparatus was designed with two ends in view—smallness of cost, and simplicity in design, to ensure its adaptation for use in large classes. The kymograph was especially admirable for its cheapness and completeness; the moist chamber for muscle work and the combination heart lever were very complete. The artificial circulation scheme was simple, compact, and fully adapted for illustrating all the essential physical features of the circulation. There were several other pieces—induction coil, frog boards, etc., all equally good, and not only adapted for demonstration work but also for research work, showing accuracy of construction.

DR. REICHERT showed some pieces of fine apparatus with many convenient mechanical appliances; a kymograph, and sets of levers all adjustable with one screw as well as having individual adjustments.

DR. CURTIS described a method of preparing mammalian muscle for demonstration. He injects a strong solution of curare into the cat, and when it is dead the removed muscle wrapped in moist filter paper will be efficient for one or two hours, giving the advantage in demonstrations, of large movements.

DR. W. O. ATWATER added some points on his experiments in regard to the nutritive value of alcohol. His experiments were very carefully conducted, but lasted for only four days; his subject showed that by giving a known amount of alcohol containing an amount of energy equal to that possessed by a given amount of carbohydrate food, an equivalent of energy could be obtained. In so far the experiment proved alcohol to be a food. The conditions of the experiment, however, did not show the results of the use of alcohol as a fuel for long periods of time or in excessive quantities. It is quite probable that the animal organism uses alcohol at a sacrifice which does not become apparent in these short experiments, but proves disastrous after longer periods.

DR. C. S. MINOT reported a clear case in telegony giving negative results; guinea pigs, the ancestry of which was known for many generations, were crossed with an animal of distinctly different color, probably of wild stock. None of the females previously mated with this male, when mated with the ordinary type later, showed in their offspring any retained influence of the first father. While the young by the first male showed a full share of the father's coloration, none ever appeared in later offspring by different fathers.

DR. T. B. ALDRICH gave further notes on the pharmacology of chloretone, a new anæsthetic. This is given in an aqueous solution .2 to .25 of a gram per kilo of the animal to be used if recovery is desired. It is given by the stomach and has the advantage over ether and chloroform of not lowering the blood pressure. An interesting discussion followed.

The Psychological Association had a full and most interesting meeting. On the first day a mathematical prodigy was present and gave some good illustrations of how he obtained his results.

PROF. JOHN DEWEY gave his president's address on "Psychology and Social Practice," which was followed by a most interesting discussion on "How Should Psychology be Taught?" by Professors Fullerton, Jastrow, Aikin, and Judd; the result of which was for a full use of laboratory methods for illustration, but also a careful direction and oversight of these for their special application and significance in the more purely theoretical sides of the question. The meeting then divided into two sections, one for Philosophical Psychology and one for Experimental Psychology. The latter section held its meetings in the Psychological laboratory, and much interest was aroused by the exhibition of many pieces of apparatus and a discussion of their uses. One of the most interesting papers was by PROF. SCRIPTURE, on the question of electrical anaesthesia. By local applications of electrodes to the skin a fairly complete local anaesthesia is produced, so that no sensation to stimuli, such as pin pricks, remains. Surgical anaesthesia has not as yet been obtained, but there is every reason to anticipate such a result.

The Association of American Anatomists opened with the address of the president, DR. B. G. WILDER of Cornell, on the "Historic, Ethical, and Practical Considerations Respecting the Names and Numbers of Definitive Encephalic Segments." In this address the question of brain segments was laid clearly before the anatomists with the hope of arriving at some definite conclusion on some of the points at issue. The importance of convenience as well as precedence was emphasized. A later paper by the same author dealt with the question of "The Basis and Nature of a Segmental Schema of the Brain"; in this the question of five or six primary brain segments was discussed and the true nature of such divisions as arise either primarily or secondarily.

Dr. HRDLICKA showed some parietal domes of infants' skulls having curious foramina along the sutures not far from the edge.

DR. WILLIAM KEILLER spoke on "How to Teach Anatomy to Third Year Medical Students."

At the general session the proposition was accepted to authorize the members meeting in Chicago, December 28th and 29th, to join a Western branch of the association, and arrangements were made for a joint committee of five members,

three to be appointed by the New Haven meeting and two by the Chicago meeting, for disposing of joint funds.

PROF. DWIGHT of Harvard Medical School was then introduced by President Farlow, as the first speaker in the discussion on "The Position that Universities Should take toward Investigation." Prof. Dwight held that research should be encouraged by universities in every way possible; but stated that he felt it should hold a subordinate place in required medical work. Opportunity should be given to any desiring advanced work to undertake it, but no arduous demands should be made upon the average student.

PROF. CHITTENDEN of Yale spoke of the value to the teaching staff of the university of regular opportunities for research; a certain amount of time should be set aside for investigation by each member of the teaching staff, and their time never fully occupied by instruction work. In this way better teaching is obtained and the more skilled investigators set free to work to advantage.

PROF. MACDOUGAL of the New York Botanical Gardens spoke of the strengthening and broadening influence of investigation, and the advantage to young students of seeing maturer workers in their researches, giving the point of example.

PROF. JASTROW of Wisconsin was in harmony with the preceding speakers, and referred especially to the absolute necessity for investigation on the part of the teacher in psychology. Without it there would be very little real correlation between the many points of view, and no advance would be made in knowledge or methods of teaching.

PROF. PATTEN of Dartmouth closed the discussion by making a plea for wider training of a student before encouragement is given for investigation. Too often the student goes deeply into a small branch without a wide basis of experience first, and narrow and incomplete conclusions result from too few or too restricted observations. The result of the whole discussion was to show clearly two sides, one the advantage of leisure for investigation to the teacher, the importance of which cannot be over estimated; every chance given to teachers for such study adds to their value as teachers if they are qualified in the first place, and gives them a chance to do what they are best fitted for if they are not teachers by preference; investigation being as truly a part of the university's life and welfare as teaching. The second phase of the question lies in the value of such work to students. The result of this view is that not all students can investigate, and for the majority more general methods of instruction are better; but chances should be given to develop any latent powers in that line by offering studies in research methods.

At the general evening meeting PROF. VERRILL of Yale gave a most interesting lecture on the "Geology and Natural History of the Bermudas." The lecture was illustrated by many lantern slide views of the fauna, most beautifully colored by Mr. A. H. Verrill from specimens in the Aquarium in New York city; the most striking features about all the animals were their brilliant colors, remarkable shapes, and often great size; there were also many curious protective devices.

The officers for the coming year are: President, E. B. Wilson, Columbia;

Vice-Presidents, R. F. Thaxter, Harvard, F. P. Mall, Johns Hopkins, H. S. Williams, Yale; Secretary, A. D. Mead, Brown; Treasurer, M. N. Metcalf, Woman's College, Baltimore; Members of the Executive Committee, W. W. Rowlee, Cornell, J. S. Kingsley, Tufts College.

The social event of the meeting was a reception given in Alumni Hall to the members and invited guests. A large number were present, and in every way the evening passed off most pleasantly; this being the only general social event of the session, gave the best chance for seeing the different members of the many sections.

A new association was formed by the Bacteriologists, of which Dr. Sedgwick of Boston was elected president. Twenty-five papers were sent in, fifteen of which were read. Dr. Theobald Smith of Washington read a paper, and some important points in connection with sanitation were discussed.

A. M. CLAYPOLE.

The Society of American Bacteriologists.

At the New Haven meeting of the American Naturalists during the Christmas holidays, a number of the leading bacteriologists of the country met for the purpose of forming a society of bacteriologists. As a result of the meeting there was organized a society which is the first in the country, and probably the first in the world, organized for the distinct purpose of studying and discussing bacteriological problems. The society will, in general, meet with the American Naturalists. The opening meeting was very auspicious, there being over thirty in attendance. The persons joining in the organization of the society included bacteriologists whose lines of study covered a wide range of subjects. Among them were those devoted to the study of pathology; others studying hygiene. Others, again, are engaged in the investigation of agricultural topics, and yet others are interested in the industrial problems of bacteriology. Some papers were also presented upon purely biological aspects of bacteria. The wide range of branches represented indicated the extent to which bacteriology has attained in the short years of its existence as a branch of science, and plainly pointed out the need of some organization to centralize the work and bring to a common point information of mutual interest.

The society elected the following officers for the ensuing year:

President—Prof. W. T. Sedgwick, Massachusetts Institute of Technology.

Vice-President—Prof. A. C. Abbott, University of Pennsylvania.

Secretary and Treasurer—Prof. H. W. Conn, Wesleyan University.

Council—Prof. Theobald Smith, Prof. Harold Ernst, Prof. E. O. Jordan, and Dr. E. A. de Schweinitz.

In addition to the work of organization the following list of papers was read:

"Natural Varieties of Bacteria."
H. W. CONN, Wesleyan University.

"The Significance of Varieties among Pathogenic Bacteria."
THEOBALD SMITH, Harvard Medical School.

"Some Suggestions in the Study of Systematic Bacteriology."
F. D. CHESTER, Delaware College Agricultural Experiment Station.

"Methods Employed in the Teaching of Bacteriology."
H. C. ERNST, Harvard University.

"Experimental and Statistical Studies on the Influence of Cold upon the Bacillus of Typhoid Fever and its Distribution."
By W. T. SEDGWICK, and C. E. A. WINSLOW, Massachusetts Institute of Technology.

"The Importance of Bacterial Tests in the Sanitary Supervision of Municipal Milk Supplies."
M. O. LEIGHTON, Board of Health, Montclair, N. J.

"The Bacterial Invasion of the Normal Udder."
ARCHIBALD K. WARD, Agricultural Exp. Station, Cornell University.

"Significance of the Appearance of Bac. Coli Com. in Filtered Waters."
H. W. CLARK and S. D. GAGE, Lawrence Exp. Station of Massachusetts State Board of Health.

"On the Detention of Bacillus Coli Communis in Water."
E. O. JORDAN, University of Chicago.

"A Comparison of B. Coli Communis from Different Species of Animals."
V. A. MOORE and FLOYD R. WRIGHT, Cornell University.

"Recent Work on Sewage Purification Involving Bacteria."
H. W. CLARK, State Board of Health, Massachusetts.

"On the Change of Opinion in England in Favor of the Bacterial Purification of Sewage."
PROF. L. P. KINNICUTT, Polytechnic Institute.

"On the Bacteriology of Canned Foods, with a Detailed Account of Bacteria Detected in Sour Corn."
S. C. PRESCOTT and LYMAN UNDERWOOD, Massachusetts Institute of Technology.

"A New Pathogenic Fungus (Sporothrix of Schenck)."
LUDWIG HEKTOEN, Rush Medical College, Chicago.

"Demonstration of Actinomycosis and the Causative Fungus."
H. C. ERNST, Harvard University.

"Exhibition of Cultures and Stained Specimens of Plague Bacillus from Two Cases of Bubonic Plague Admitted to New York Harbor, November, 1899.
WILLIAM HALLECK PARK, Laboratory of New York Board of Health.

"Notes on the Effect of Blood Serum from Tuberculous Animals and Men on the Tubercle Bacillus when Mixed with it in the Culture Tube and Hanging Drop."
WILLIAM HALLECK PARK, Laboratory of New York Board of Health.

Bacteriologists desiring information concerning the society can apply to the secretary, Prof. H. W. Conn, Middletown, Ct.

New York State Science Teachers' Association.

The fourth annual meeting of the New York State Science Teachers' Association was held at Syracuse, Thursday and Friday, Dec. 28–29, 1899. The registered attendance was somewhat over one hundred. Unusual interest was manifested in the papers presented and in the discussions that followed.

At the first meeting of the Association, held at Syracuse in 1896, a Committee of Nine was appointed by the president "to report to the Association on

the three following subjects: (1) the recognition of science as a requirement for entrance to colleges; (2) science courses for secondary schools; (3) nature study in elementary schools." To facilitate the work of the committee a subcommittee was appointed for each science "to define its educational value, point out right methods of teaching it, and recommend proper subject matter for the courses—in a word, devise ways to make it more useful in the schools."

The reports on nature study, earth sciences, botany, and physics were presented to the Association by the Committee of Nine, discussed and adopted at the 1898 meeting at Columbia, and published in the Proceedings of this Third Annual Meeting, issued by the Regents of the University of New York. During the past year, reports on the teaching of zoölogy and chemistry were prepared, thus completing the consideration of the subjects for which the Committee of Nine was chosen.

In the discussion of the earlier reports there had been considerable disagreement as to the proper sequence of sciences in the secondary schools. Should physics and chemistry precede biology? Should we adopt the sequence recommended by the National Education Association (first year, physical geography; second year, biology; third year, physics; fourth year, chemistry)? Or what should be regarded as the best order in which the sciences shall be studied? A consideration of this general question was, therefore, put first upon the programme of the meeting at Syracuse, last December. Principal T. B. Stowell (Potsdam Normal School), who led the discussion, maintained that, in so far as the four sciences named above are concerned, there is no logical order in which they must be taken up, and that the question of sequence must be determined by utilitarian or prudential considerations. "From the utilitarian view it may be argued that no group of studies has more direct reference to the phenomena of life than the biology group when studied with reference to man as the final cause. . . It is the judgment of the writer that the biologic group should come early in the course."

In the paper of Prof. J. F. Woodhull (Teachers' College, N. Y.), which followed Principal Stowell's, it was maintained that in the logical order of the sciences, physics and chemistry must always precede biology; and that from the ease with which chemistry can be taught, and because of its practical importance, this subject should be presented in the first high school year. Mr. W. F. Langworthy (Colgate Academy) suggested that the secondary school course in science should begin with physics. From this brief review it becomes evident that there is wide divergence in regard to the proper sequence of the sciences, and this fact became even more apparent in the later discussions of the Syracuse meeting. The study of biology in the first year must of necessity differ widely from work in this subject planned for the third or fourth year. If, therefore, science teachers are to come to any substantial agreement as to what shall constitute a satisfactory course in a given subject, they must first agree upon the year in which the science is to be taught.

Thursday afternoon was devoted to the consideration of the subcommittee reports on chemistry and zoölogy in the section meetings. The majority of the committee appointed to consider the subject of zoölogy presented the syllabus

of a course designed for the third year of the high school. The following animal forms were suggested for a year's course: amœba, paramœcium, hydra, anemone, starfish, sea-urchin, earth-worm, trichina or tape-worm, crayfish or lobster, spider, grasshopper, butterfly, mussel, snail, amphioxus, fish, frog or toad, turtle, bird, cat or rabbit. The syllabus includes suggestions for collecting each of the forms mentioned, for the study of the living animal, and for the dissection of preserved specimens. The minority of the committee maintained that zoölogy would best be taught in the first or second year, thus preceding physics and chemistry; and that but little time should be taken for dissection.

In the annual address, President LeRoy C. Cooley (Vassar College) reviewed the history of science teaching in the schools, and suggested that the two great problems which the Association could help in solving were (1) the proper sequence of the sciences in the school curriculum, and (2) the correlation of the courses in science with those in other subjects.

Earth science in the secondary schools was considered on Friday morning by Mr. W. H. Snyder (Worcester Academy, Mass.) and by Mr. R. H. Cornish (Girls' High School, N. Y. City). One of the most interesting discussions of the whole meeting was aroused by Dean W. H. Crashaw's (Colgate University) paper on "College Entrance Requirements in Science." Some of his statements were these: "There does not seem to be, so far as I can discover, any real consensus of opinion as to just what science should claim for itself in the field of secondary education. I am no advocate of a dead uniformity; but if science is to attain its ends, there must be a reasonable agreement as to its desires, its methods, and its aims. How is such a degree of uniformity to be attained? There seems to be only one answer. Teachers of science, by consultation, by discussion, by experiment, must arrive at some sort of common understanding as to a practicable mode of procedure, and it is doubtless through such associations as this that such an understanding may best be reached. . . . With some hesitation, I will venture to suggest that a reasonably good course might be made by teaching for one year each three typical subjects, each representing one of the three great divisions of science—the physical sciences, the earth sciences, and the life sciences—and then following this by an advanced year in some one of these subjects. . . What is it, then, that the college ought to expect from the scientific teaching of the schools in addition to good quality and proper method. First, I think, that school courses should be well defined, so that the college may estimate the amount and kind of work done and know precisely what it is asked to accept. Secondly, that at least a full year's work should be given in each branch of science treated. Thirdly, that the school courses should be of such a character that advanced college work may be based upon them."

The final topic of the morning session was "The Training of Science Teachers for Secondary Schools." Prof. E. L. Nichols (Cornell University) made the following suggestions for the better preparation of science teachers: "The principal weakness in the teaching of science in the secondary schools at the present day does not arise from ignorance of method, but from the lack of a mature and well established acquaintance with the science itself. It may seem to be demanding much to insist that every science teacher should be, in some real sense of the

word, an investigator; but it is my conviction that only in so far as our science teachers become men of science in the sense of having the particular science which they are teaching woven into their mental fabric, can we hope for really satisfactory results. . . Whatever of training in the methods of teaching may be deemed desirable should follow rather than precede the foregoing. . . No institution, the members of the faculty of which are not themselves bona fide men of science, devoting themselves quite as seriously to research as to routine teaching, can hope to produce in its students those habits and qualities of thought that I have endeavored to show are essential to the highest type of teacher."

Laboratory equipment and the management of laboratory classes were the topics discussed in the three section meetings (biology, physics and chemistry, and earth science) Friday afternoon.

A complete account of the meeting is promised by the Regents at an early date under the title "Proceedings of the Fourth Annual Meeting of the N. Y. State Science Teachers' Association." The next annual meeting will be held in Rochester during Christmas week. Following are the officers for the ensuing year: President, Charles Wright Dodge, University of Rochester; Vice-President, Albert P. Brigham, Colgate University; Secretary and Treasurer, O. C. Kenyon, Syracuse High School. Executive Council: A. D. Morrill, Hamilton College; E. W. Wetmore, Albany Normal School; H. R. Linville, Boys' High School, N. Y. City; C. N. Cobb, Regents' Office; F. W. Barrows, Buffalo High School; Mrs. Anna B. Comstock, Ithaca; William Hallock, Columbia University; Mary E. Dann, Girls' High School, Brooklyn; E. W. Whitney, Binghamton High School; J. H. Stoller, Union College; T. B. Lovell, Niagara Falls High School; W. C. Peckham, Adelphi College, Brooklyn.

JAMES E. PEABODY, Secretary.

NOTES ON THE BIOLOGICAL SECTION.—Arthur G. Clement, chairman of the second session of the Biological Section, took up the question of the equipment of laboratories for secondary schools, and discussed laboratory plans, devices for teaching, apparatus, etc. As a matter of course, he was in favor of a laboratory, supplied with plenty of apparatus if it could be obtained, and if it could not be obtained all at once, a few pieces should be added whenever possible until a supply was accumulated. Dissecting instruments, magnifying glasses and compound microscopes, charts and preserved specimens, are highly desirable; but the most important part of the equipment is a good teacher. The essentials for work in botany and zoölogy are a teacher, a pupil, and a specimen. The same idea was brought out at the first meeting of the section, at which Prof. C. W. Dodge presided. He recalled the work done in the laboratory established at Penikese by Agassiz. The laboratory was little more than a shed and there was the merest apology for equipment, but work was done under the inspiration of the leader that was not equalled later when material conditions were more favorable to success.

Professor Dodge presented an outline for a twenty weeks' course in zoölogy that would be perfectly practicable in all secondary schools. He favored the dissection of specimens, and referred to a letter from Dr. Lewis Murbach of the

Detroit High School, who carries out a similar course in his school, and has the students do enough dissection to show the internal anatomy of the specimens—all that is necessary in any dissection.

In a general experience meeting following the regular program, one member asked for suggestions as to honest methods for obtaining chickens in sufficient numbers to provide each member of a large class with a specimen for dissection, the regular fund for that purpose having been exhausted. Chickens are preferable for the work, because students who dislike dissection have less antipathy for something they have always been accustomed to see prepared as food. The English sparrow was brought in as a dark horse, and it was decided that, as this bird, a familiar object, is easily obtained and serves every purpose, it might be given a *raison d'etre* by furnishing material for dissection.

Dr. H. A. Surface of Ithaca asked for the support of the association in presenting a petition to the League of Fish, Game and Forestry Protection for the establishment of a biological station similar to the one now in operation in Illinois. He thought that a houseboat which could be moved about the state, from Lake Chautauqua to Lake Champlain, and could be placed at the disposal of investigators and teachers, would be of great value in carrying on studies and in collecting material. Dr. Gage of Cornell University cautioned the association against identifying themselves with a petition of this sort, which might be made political capital, and the question was laid on the table.

The committee of nine gave a report to the general effect that work in science must be organized and given the time and equipment necessary to place it on an equality with work in other lines.

All of the meetings were characterized by the greatest enthusiasm, and from the presence of two nuns throughout the session it is apparent that interest in scientific work is extending into new fields.

To Prevent Sections from Drying.

In the staining of sections after cutting and mounting on the glass slide, I have frequently been embarrassed by evaporation of the alcohol from the stain in cases where material had to be left in stain over night. This was of course a matter of considerable annoyance until I happened to strike upon the following wrinkle, which entirely overcame the difficulty, and which, I hope, may be of service to some laboring microscopist who may find himself in the same predicament. Lay two pieces of good-sized glass tubing (one-half or two-thirds inch) on each side of the bottom of a large Petri dish, and extend a strip of glass about three inches wide from one to the other. This will of course make a sort of bench near the bottom of the dish. Fifty per cent. C_2H_5OH may now be poured in, but not sufficient to come up to the top of the bench on which the slides are to be laid. A good-sized drop of stain may now be put on each slide and the cover of the dish put on. Material handled in this way may be left to itself for several days without danger of the stain evaporating.

R. P. WOODFORD.

METHODS IN PLANT HISTOLOGY.

CHARLES J. CHAMBERLAIN.

XI.

PTERIDOPHYTA.

This group, including the Filicineæ, Equisetineæ, and Lycopodineæ, or more popularly, the ferns, horsetail rushes and club mosses, is familiar to every one. Material is abundant and so easily recognized that anyone who pays a little attention to collecting can, in a single season, get a fine supply for a study of the group. Some desirable forms may not be present in all localities, but these will be few and can be obtained at a reasonable price from those who make a business of collecting.

FILICINEAE.

Without attempting to follow any taxonomic sequence, the methods of preparing the various structures of the homosporous forms will be presented, and then the peculiarities of the heterosporous members will be considered.

The prothallia.—Ripe spores of some fern or other can be obtained at any greenhouse at any time in the year, and spores of most of our native ferns germinate well and produce good prothallia even if the sowing is not made for several months after the spores have been gathered.

Fine prothallia of *Pteris aquilina* have been grown two years after the spores were gathered. Some, however, must be sown at once, or they will not germinate at all. The spores of the common *Osmunda regalis*, and probably of the other members of the genus, must be sown as soon as ripe or they fail to germinate. The prothallia of *Osmunda regalis*, if carefully covered with glass, may be kept for a long time. Prothallia of this fern in the writer's laboratory produced ribbon-like outgrowths three-sixteenths of an inch wide, and often more than two inches in length. These prothallia continued to produce archegonia, antheridia, and the ribbon-like outgrowths for more than a year, when they suddenly "damped off." *Pteris aquilina* and many other ferns often furnish a good supply of antheridia in three weeks after sowing, and the archegonia appear soon after, but it is well to make sowings six weeks before material is needed for use. In *Pteris aquilina* and in many others, if the spores are sown too thickly, only antheridial plants will be obtained. If prothallia are to produce archegonia they must have sufficient room and nutrition. If there are no greenhouse facilities and the prothallia must be grown in the laboratory, it is a good plan to take a glass dish, ten or twelve inches in diameter and about two inches deep, put a layer of broken pieces of flower pots on the bottom, cover this with a layer of rich loam, and over this sprinkle a layer of fine, clean sand, since sand is much more easily washed away from the rhizoids than is the loam. The whole should now be thoroughly wet, but not so as to have water standing on the bottom. Sow the spores and cover with a tightly fitting pane of ground glass. There should be no need for moistening the culture again, for prothallia can be kept

fresh and vigorous for several months or even for a year without any wetting. When it is desired to secure fertilized material, sprinkle the prothallia with water and the young sporophytes will soon appear. If greenhouse facilities are available any gardener can grow prothallia in abundance without any directions from those who want the material.

Fern prothallia are excellent objects for testing fixing agents, since the prothallia, while still in the fixing agent, may be examined with the microscope, and fluids which cause plasmolysis may be rejected. It will sometimes happen

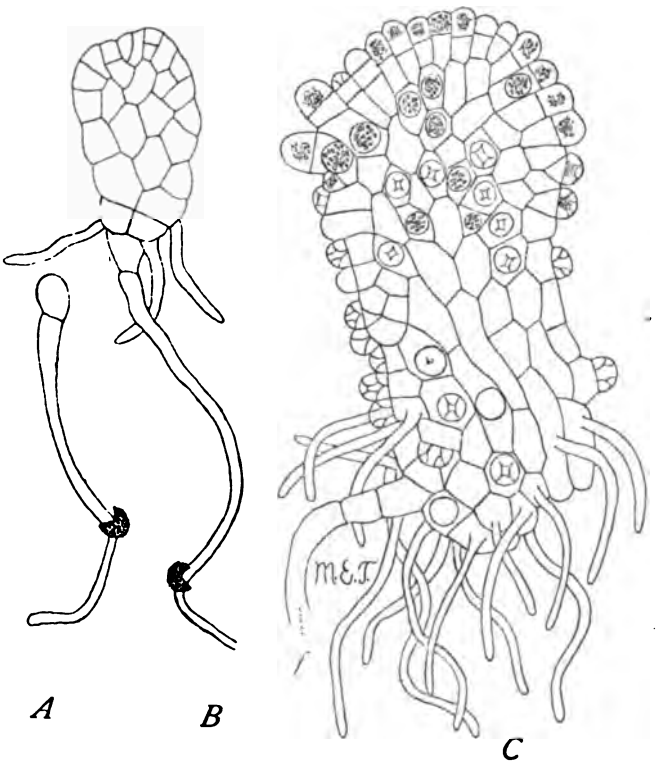

Fig. 1. Pteris aquilina.
A. Filamentous stage. B. The apical cell has been established and several segments have been cut off. The figure shows the initial rhizoid, and also three rhizoids coming from the main body of the prothallium. C. An older prothallium covered with antheridia in various stages of development. From a glycerine mount, fixed in chromo-acetic acid and stained in Delafield's hæmatoxylin. (Miss M. E. Tarrant.)

that plasmolysis may be avoided by varying the proportions of the ingredients of a fixing agent. Chromo-acetic acid with about 0.6g. chromic acid and 0.4 cc. of acetic acid to 100 cc. of water will seldom cause plasmolysis, and will usually insure good fixing. It is a mistake to suppose that because prothallia are such delicate objects the fixing will take but a few minutes. We should recommend at least ten hours in chromo-acetic or Flemming's fluid, and twenty-four hours will do no harm and may be better. If hot corrosive sublimate-acetic acid or hot picro-acetic be used, the fixing requires only two or three minutes, but results are not as uniformly successful as with members of the chromic acid

series. After any of the chromic acid series, two or three hours washing in water will be sufficient if the water be changed as often as it becomes in the least degree discolored.

If preparations are to be mounted whole, as shown in Fig. 1, they should be stained as soon as the washing is finished. Any of the following methods gives good results:

(*a.*) Stain in Mayer's hæmalum six hours or over night, wash in water ten minutes, and transfer to ten per cent. glycerine.

(*b.*) Stain in Delafield's hæmatoxylin thirty minutes, wash in water five

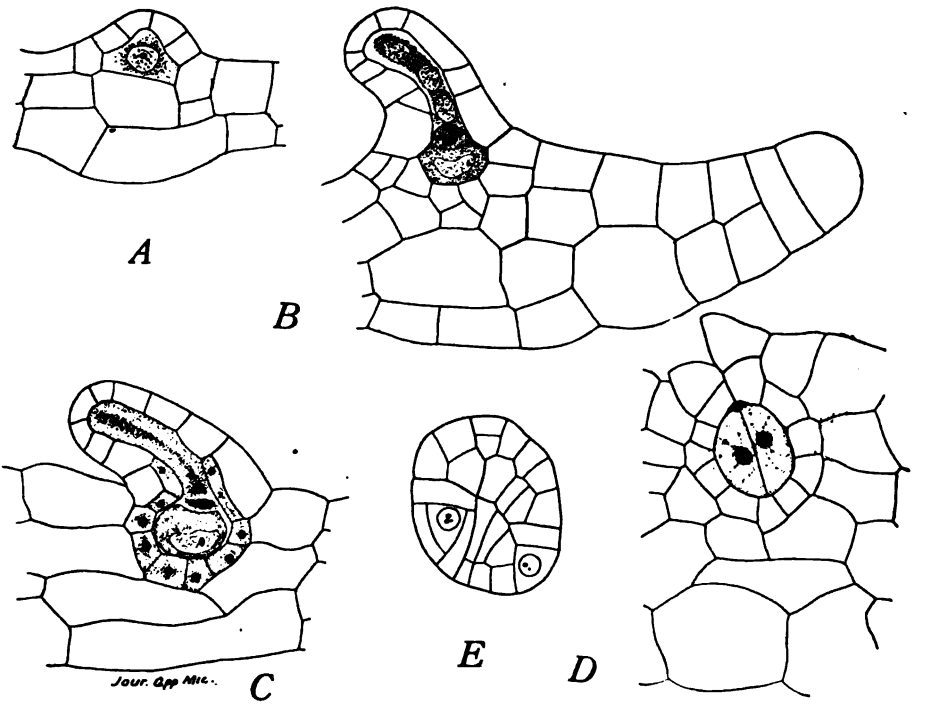

Fig. 2. Pteris cretica. × 250.

A. Early stage in the development of the archegonium. B. Later stage showing the oosphere, ventral canal cell, and *three* nuclei in the neck canal. C. Still later stage almost ready for fertilization. The ventral and neck canal cells are breaking down, and the oosphere is nearly mature. Cells surrounding the oosphere have become richer in protoplasmic contents and stain more deeply. D. First division of the embryo. E. Young embryo still showing the outlines of the four quadrants. The apical cell in the lower left quadrant has cut off the first layer of the root cap. All drawn from material stained in bulk in alum carmine, a method not to be recommended.

minutes, decolorize in water acidulated with hydrochloric acid (1 cc. HCl to 100 cc. water) five to thirty seconds—the time can be determined only by experiment—wash in water until the rich purple color of the hæmatoxylin replaces the red to the acid, and then place in ten per cent. glycerine.

(*c.*) Stain with Delafield's hæmatoxylin as in (*b*), and after the last washing in water stain two to four minutes with an aqueous solution of eosin, wash thoroughly in water and transfer to the ten per cent. glycerine. Instead of using the acid alcohol after the hæmatoxylin, the eosin may be allowed to act for several hours, and then one per cent. acetic acid may be used for a few minutes.

Wash very thoroughly in water, and if the stains appear satisfactory, transfer to ten per cent. glycerine as before.

(*d.*) Use a two per cent. solution of iron alum two hours, wash in water five minutes, stain in one-half per cent. hæmatoxylin two to six hours, wash in water five minutes, and then treat again with iron alum until the stain is satisfactory. Wash thoroughly in water and transfer to ten per cent. glycerine, which, as usual, will concentrate sufficiently for mounting in three or four days.

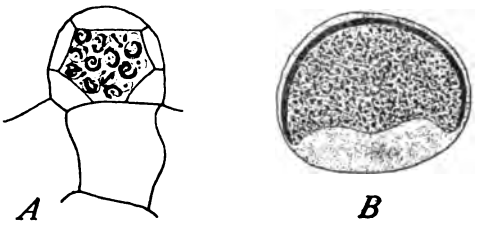

Fig. 3. Pteris cretica.
A. Section of a nearly mature antheridium showing the antherozoids inside. × 333. B. A developing antherozoid showing the blepharoplast drawn out into a deeply staining band. × 1900. Fixed in chromo-acetic acid and stained in Heidenhain's iron alum hæmatoxylin.

For paraffin sections such as are shown in Figs. 2 and 3, the material should be passed through the alcohols, allowing about one or two hours for each grade. The mixtures of xylol and absolute alcohol need not take more than an hour, and as soon as the pure xylol has been added, the piece of paraffin may be added at the same time. In the bath, five to fifteen minutes will usually be sufficient. It would be worth while to determine the duration of the bath for such objects. If bergamot oil be used instead of xylol, there is less danger of collapse previous to the bath, but the bath itself must usually be more prolonged, since the bergamot oil is not so easily gotten rid of as is the xylol.

For morphological purposes sections 15 μ to 20 μ thick are better than thinner ones. Delafield's hæmatoxylin, with or without a counter stain with erythrosin, is good for such sections as are represented in Fig. 2. If very thin sections are wanted for cytological study, it is better to use the safranin-gentian violet-orange combination. For such views of antheridia as are shown in Fig. 3, Heidenhain's iron alum hæmatoxylin seems to bring out the blepharoplast (centrosome) most sharply.

The sporophyte. — Methods for young sporophytes like those shown in Fig. 2, D and E, are the same as for archegonia and antheridia.

Root tips to show the prominent apical cell are easily imbedded in paraffin. They should be cut 15 μ to 20 μ thick. Delafield's hæmatoxylin without any contrast stain, or fuchsin and iodine green, are good stains.

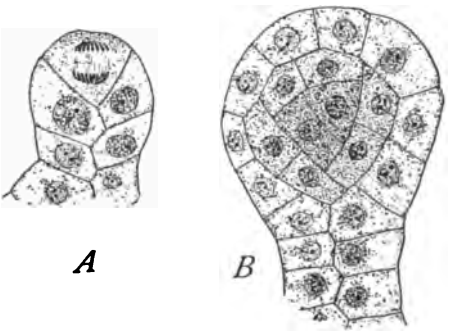

Fig. 4. Pteris cretica. × 560.
B. Young stage in the development of the sporangium. B. Older stage showing the tapetum. Fixed in chromo-acetic acid and stained in Delafield's hæmatoxylin and erythrosin.

Sporangia should also be cut in paraffin. *Pteris* is a good form for sporangia since the long marginal sorus makes it possible to get an immense number of median longitudinal sections of sporangia in a single preparation. *Aspidium* and *Cyrtomium* give beautiful views of the indusium, covering the cluster of

sporangia. In young sporangia of *Osmunda* the X, Y, and V shaped chromosomes could hardly be excelled.

Preparations of the woody structures of the sporophyte are easily made. The rhizome of *Pteris aquilina* affords as good material as any. In digging up rhizomes, do not merely dig down until the rhizome can be grasped, and then pull it up, for such material is sure to show the pericycle of the bundles torn away from the parenchyma. Dig carefully around the rhizome and then cut off with a very sharp knife pieces about two inches in length. Put the fresh rhizome into the hand microtome and cut as thin sections as possible. Keep the knife wet with ninety-five per cent. alcohol and put the sections into ninety-five per cent. alcohol as fast as they are cut. Fifteen or twenty minutes is sufficient for fixing. Pass down through the grades of alcohol, about two or three minutes in each grade. Stain in safranin twenty-four hours, wash in water ten minutes, and then stain in Delafield's hæmatoxylin ten to twenty minutes. Pass through the alcohols, about one minute in each grade, at seventy per cent. alcohol transferring to acid alcohol from one to five seconds, then pass on, clear in xylol and mount in balsam. If the stain is successful, the xylem should show a brilliant red, and the cellulose walls a rich purple.

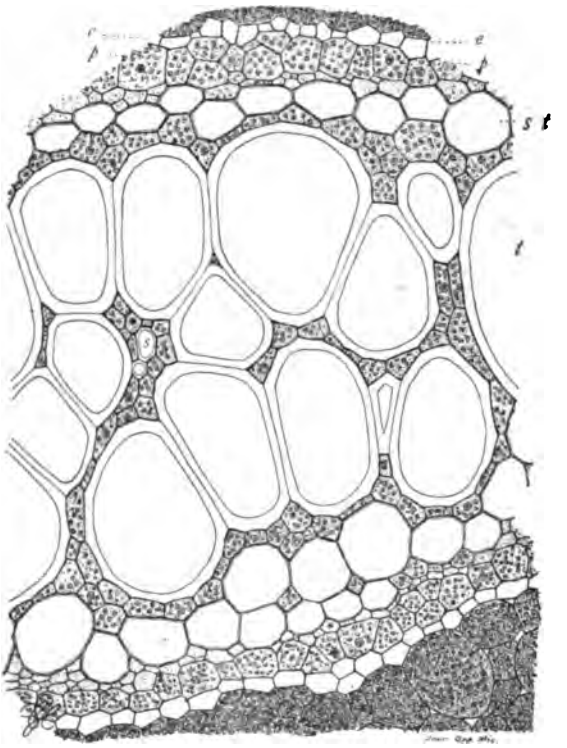

Fig. 5. Pteris aquilina.

A part of a transverse section of the vascular bundle of the rhizome × 166. *e*. Endodermis. *p*. Pericycle. *st*. Sieve tube. *t*. Scalariform tracheid. Drawn from a celloidin section from material fixed in picro-acetic acid and stained in Safranin and Delafield's hæmatoxylin.

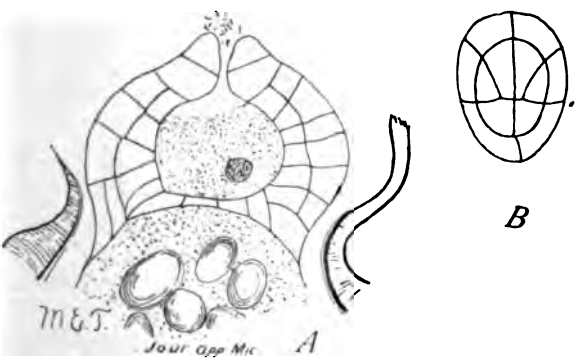

Fig. 6. Marsilea quadrifolia. × 333.

A. Apex of macrospore with archegonium containing the oosphere. Large starch grains are shown beneath the archegonium. B. Young embryo. Both fixed in picro-acetic acid and stained in Delafield's hæmatoxylin. (Miss M. E. Tarrant.)

Another method is to stain for about twenty minutes, or several hours, in iodine green or methyl green, rinse in seventy per cent. alcohol until the green is prominent only in the xylem, then stain for from one to three minutes in acid fuchsin (one per cent. solution in seventy per cent. alcohol), dehydrate rapidly, clear in xylol, and mount in balsam. The xylem should have a sharp, bright green color, and the cellulose a bright red.

The most beautiful preparations may be obtained by embedding in celloidin and staining in safranin and Delafield's hæmatoxylin. These stains allow a use of acid which extracts all color from the celloidin and still leaves a sufficient amount in the tissues. The large apical cells of rhizomes are easily cut in either paraffin or celloidin.

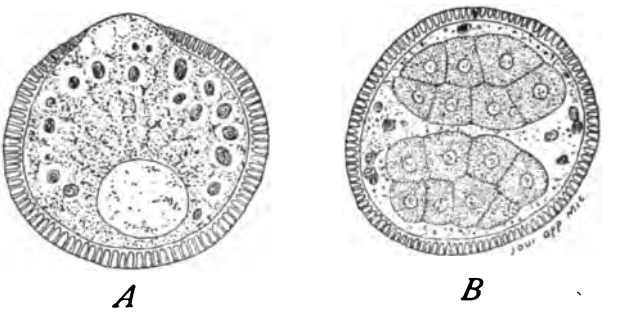

Fig. 7. Marsilea quadrifolia. × 560.
A. Microspore before germination. B. Microspore with antheridia nearly mature. Fixed in chromo-acetic acid and stained in safranin-gentian, violet-orange.

The macrospores and microspores of *Marsilea* are easily obtained. Cut away a portion of the hard sporocarp and place the sporocarp in a dish of water. The gelatinous ring with its sori will sometimes come out in a few minutes. In less than twenty-four hours the microspores, starting from the one cell stage, will produce the mature antherozoids. The development of the macrospore is equally rapid. Embryos are abundant in two or three days. For morphological work, picro-acetic acid, used hot, is very good since the material does not occasion so much difficulty in cutting. Chromo-acetic material allows better staining, but the cutting is more uncertain. It is best to prick the macrospores with a needle while they are in the fixing fluid in order to facilitate the infiltration of paraffin. Better mounts of the microspores can be obtained if the troublesome macrospores be picked out from the sorus while the material is still in the fixing agent or the alcohols. The macrospores must be embedded in rather hard paraffin, and one must expect to hone the knife thoroughly before it can be used again, for when the knife strikes a macrospore of one of the heterosporous pteridophytes it seems like striking a grain of sand.

As Fig. 6 suggests, the mature archegonia, and especially the young embryos, may be dissected out from the top of the macrospore and cut with perfect ease.

The spermatozoid, which in *Marsilea* has an unusually large number of turns in the spiral, may be mounted by methods already described.

EQUISETINEAE.

Prothallia of *Equisetum* are easily grown by the method already described for the Filicineæ, but the spores must be sown as soon as ripe, because they fail to germinate if kept more than a few days. The methods of preparing prothallia are the same as for the Filicineæ. The sporangia are harder to cut, but good

preparations should be secured from paraffin material. *Equisetum arvense* is abundant everywhere, and is to be preferred on account of the comparative ease with which sporangia and other portions of the fertile shoot can be cut. Material for sporangia should be obtained as soon as the fertile shoot appears above the ground, and if it can be secured earlier, so much the better. When the spores are shed, the young sporangia, which are to develop the next year, can already be detected.

LYCOPODINEAE.

It is not very difficult to get paraffin sections of young sporangia of *Selaginella*. Young fruiting spikes may be fixed in chromo-acetic acid, but picro-acetic acid is safer for older stages on account of the extremely hard wall of the macrospores. The older macrospores had better be pricked with a needle and cut one at a

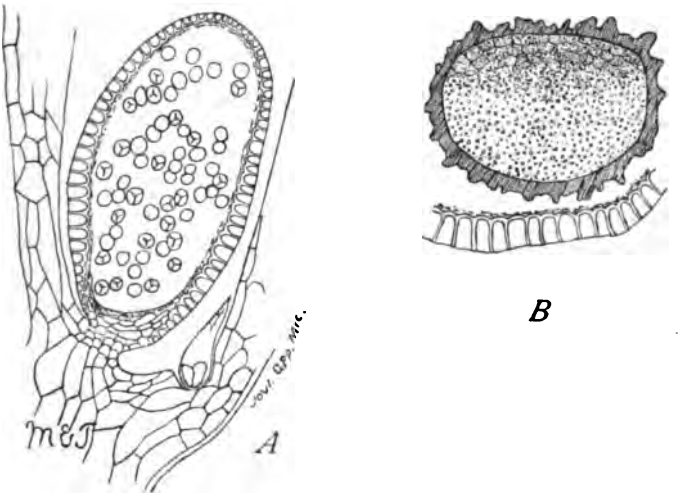

Fig. 8. Selaginella Mertensii. × 93.
A. Microsporangium containing microspores. B. A microspore showing the beginning of the prothallium. Fixed in picro-acetic acid and stained in Delafield's hæmatoxylin. (Miss M. E. Tarrant.)

time. Delafield's hæmatoxylin, used alone, is a good stain. The safranin-gentian violet-orange combination gives a brilliant differentiation in stages like Fig. 8, B. The macrospores of *Isœtes* offer the same difficulties. Cyanin and erythrosin is a fine combination for the reserve food stuffs in *Isœtes* macrospores.

For young sporangia of *Isœtes*, the leaves should be cut off about one-eighth of an inch above the sporangia, and the stem should be cut off below, leaving just enough to hold the sporangia together. Cut longitudinal sections and stain in Delafield's hæmatoxylin with or without the addition of a light touch of erythrosin. The older sporangia had better be removed and cut separately. Transverse sections of the stem are very interesting. Young stems and the apices of old ones cut well in paraffin, but older stems will give more satisfactory results in celloidin.

Sporangia of *Lycopodium* require the same technique as those of *Selaginella*, but since there are no macrospores with their hard walls, it is easier to get good sections. The directions for the rhizome of the Filicineæ will also serve for the stem of *Lycopodium*.

(*To be continued.*)

A Point in the Technique of the Cox-Golgi Staining Method.

There is a very useful point in the technique of the Cox-Golgi method of staining nerve cells, which I have seen in some German work, but which does not appear to be mentioned in most of the American descriptions of this method. This modification gives such marked results that it seems worth while to call attention to it. It consists in this: After the tissues have been passed through the Cox-Golgi fluid, embedded, and cut, the sections are immersed for a few seconds in about a five per cent. solution of potassium hydrate (*liquor potassæ*) or sodium hydrate, until the visible blackening of the sections shows that the desired result has been attained. The sections are then briefly washed in water, transferred to alcohol, and cleared and mounted in the usual manner.

The effect of the treatment with caustic alkali is to deepen the brownish or blackish color of the mercuric-bichloride-stained nerve cells to an intense black, which gives a much better appearance. After carrying specimens through the Cox-Golgi method with apparent failure, the nerve cells being completely invisible and unstained, I have in several instances found that the procedure here mentioned caused the stain to develop perfectly, making the cells visible and producing perfect results. The caustic alkali has an intensifying and developing action, improves the effect of the sublimate stain, lessens the uncertainty of the Cox-Golgi method, and at times is capable of converting apparent failure into complete success.

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A Useful Method of Staining.

Those who use paraffin as an embedding method in serial work will be glad to learn of a simple process introduced by Dr. Kukenthal, which, though not new now, is still not often mentioned. It consists in dissolving the coloring matter in absolute alcohol and dropping the solution in turpentine until the desired color is obtained. Sections are fixed to the slide with collodion kept in an oven until the clove oil has thoroughly evaporated, the paraffin is dissolved as usual, and the slide brought into dye. Staining is rapid; correct overstaining by placing for a few minutes in a mixture of acid-free, absolute alcohol and turpentine (equal parts). Turbidity of the coloring fluid may be corrected by adding a drop or two of alcohol. Almost any dyes may be used, though the blues were not permanent, unless prepared shortly before use, but when the color was obtained it was retained very well. Those who prefer to coat the slides with bleached shellac in preference to collodion will find the blue stains affect the shellac ground as well as the object, unless Mr. J. N. Gatehouse's method is followed. Take the filtered oil of turpentine and saturate with picric acid, adding the acid gradually till a fine yellow color is obtained, and scales of the acid remain undissolved. To this solution add, carefully, crystals of re-sublimed iodine, *but only a few at a time*, as otherwise the chemical action set up might

cause an explosion or ignite the turpentine. Sufficient iodine should be added to change the color of the solution from a light yellow to a distinct brown tint. This solution, when used on embryonic tissues, is capable of differentiating cartilage, muscle, and nerve tissues, especially the gray matter of the brain, which it turns brown, while the remaining structures take various shades of yellow or yellow and brown. With this compound it is possible to stain objects which after mounting in balsam have become so transparent as to be scarcely visible. All that is necessary is to place the slide in a dish containing turpentine, to which some of the stain has been added, and allow it to remain there till the balsam is softened, and the stain has penetrated and done its work, when the turpentine can be readily replaced by more balsam. Embryonic and other tissues which have faded and are invisible can be restained. Even after the tissue has been soaked two days every detail can be beautifully and clearly marked out.

V. A. LATHAM.

The Bacteria in the Stomach of the Cat.

JULIUS WEISS.

II.

In the present investigation, now to be described, the preliminary manipulations for obtaining the gastric bacteria were essentially different from those in preceding researches. Instead of the human stomach, that of the cat was employed. It was necessary to employ an animal, as the object was to obtain the bacteria directly from the mucosa of the stomach. The cat was chosen for this purpose, because it is an animal that can be placed under almost any desired conditions, and in which the digestive processes, at least, are for all practical purposes similar to those in man.

The cat was first chloroformed in an "anæsthetic box," of the Wilder & Gage pattern, until entirely unconscious. The animal, face upwards, was then stretched upon a tray and taken under a hood in the laboratory. Before an incision was made, the abdominal fur was thoroughly wetted with a five per cent. solution of carbolic acid. This step served two purposes: (1) To disinfect the fur, and (2) to prevent bits of the same flying about, when the abdominal incision was made. The instruments employed in the operation, a scalpel, forceps, and a small pair of scissors, were kept in a wide-mouthed vial, containing the same solution. When one of the instruments was to be used, it was withdrawn from the vial, and wiped with a cloth which had previously been moistened with the carbolic acid. When done with, the instrument was returned to the vial.

To remove the bacteria from the stomach, the abdominal incision was made, and the digestive organs exposed; all of them wefe then wetted externally with a five per cent. carbolic acid solution. The hands having been previously disinfected, one of them grasped the stomach, and with the other hand a careful incision was made in the lesser curvature. A loopful of mucus was then quickly removed from any desired point on the gastric mucosa, by means of a sterile platinum loop. The mucus thus obtained was then immediately inoculated into a tube of sterile agar, kept at hand at a temperature of about 45°C.

The approximate number of colonies on the first plate was estimated the next day, by means of the "Colonometer" (26).

The different species present were studied on one of the plates, on which they appeared to be isolated the best. The colonies studied were examined first with the unaided eye, then with a tripod magnifier, and finally with a two-thirds objective.

Agar-stick cultures were made from each species; and from each of these agar-stick cultures, two or three gelatin plates were made. These gelatin plates served two purposes: (1) To indicate whether a certain agar-stick culture was pure or not, and (2) it served also as a differential medium. Subcultures were then made, of agar-slant, gelatin stick, potato-slant, bouillon, Dunham's solution, milk, litmus-milk, and fermentation tubes of glucose-bouillon, lactose-bouillon, and saccharose-bouillon. All the media were prepared, as directed by Moore (27), in his "Laboratory Directions in Bacteriology."

Distinct anaerobic bacteria were not studied.

In the case of the fungi isolated from the gastric mucosa, only their gross and microscopic morphological characteristics were studied.

The microscopic morphological characteristics of the bacteria were studied in hanging drop preparations of sterile bouillon or water, or both, and in stained preparations. The stains used were methylen blue and carbol fuchsin. Measurements were made by means of an ocular micrometer.

EXAMINATIONS.

CAT 1.—This was a full grown, healthy animal. The same was kept at about 20°C. for twenty-four hours before chloroforming; and during this time was fed with crackers and milk. At the time of the operation, the stomach and the first part of the duodenum were extended with food. The colonies developed on plate 1 were innumerable.

CAT 2.—The conditions with regard to age, temperature at which the animal was kept, and the state of digestion, was about the same in this case as in cat 1. The colonies that developed on plate 1, were innumerable.

CAT 3.—This cat was kept at room temperature, and starved fully twenty-four hours. The entire alimentary canal, except the descending colon, was found empty. Four plates each were made with a loopful of mucus from the stomach, from the ileum, at about 30 cm. from the cæcum, and from the colon, at about 10 cm. from the valve.

Plate 1, inoculated with mucus from the fundus, developed only ten colonies, and contained but four distinct species—three bacteria and one fungus.

The first plates with inoculations from the ileum and colon, respectively, also developed a comparatively small number of colonies. Only the bacteria obtained from the stomach were studied.

CAT 4.—All the conditions here were practically the same as in cat 3. The number of colonies that developed on the first plates, from the different parts of the alimentary tract, approximated closely the number found in specimen 3. Only three distinct species developed on the agar plates, from the mucus of the stomach.

The following tables give the characteristics of the organisms isolated in these examinations:

Table Indicating a Few of the Properties of the Organisms Isolated from the Gastric Mucosa of the Cat.

	Size in Microns.	Agar Col.	Potato Col.	Gel. Lq.	Bl. ac.	I.	M. c.	L. m.	Gl. ac.	Gl. f. t. gas.	Lc. ac.	Lc. f. t. gas.	Sc. ac.	Sc. f. t. gas.
I.— 1. B. coli communis	.6—2×.5—.8	N. G.	Y.	—	—	+	+	+	+	+	+	+	±	+
3. Micrococcus . .	.55	P. W.	D. A.	—	—	+	+	+	—	—	—	—	—	—
5. Bacterium	.6×.5	G.	G.	—	—	+	+	+	±	+	±	+	±	+
6. Tetrad	.9	Y.	o.	—	—	—	—	—	+	—	—	—	—	—
7. Micrococcus . .	.75	O.	o.	—	—	—	—	—	—	—	—	—	—	—
II.—11. Bacillus	8.4×4.8	G. W.	G. W.	+	—	+	:|:	±	+	+	—	—	—	—
16. Micrococcus . .	.9	W.	W.	+	+	—	:|:	+	+	—	+	—	+	—
17. Bacillus	2×1	N. G.	Y.	—	—	—	+	+	+	+	+	+	±	+
18. Micrococcus . .	1	O.	Y. O.	+	—	—	+	±	+	—	+	—	+	—
21. Bacillus	6.5×2.5	W.	o.	o	—	+	:|:	±	—	—	—	—	—	—
III.—24. Micrococcus . .	1	P. W.	G. W.	—	—	—	—	—	—	—	—	—	—	—
25. Bacillus	3.5×14	W.	o.	—	—	—	—	—	—	—	—	—	—	—
26. Tetrad	.5	W.	Y.	+	+	—	+	+	+	—	+	—	+	—
IV.—28. Bacterium	.9×.75	G. W.	o.	—	+	—	—	—	+	—	+	—	+	—

NOTE.—N.—neutral. A.—ash. W.—white. D.—dark. P.—pearly-lustre. G.—gray. O.—orange. Y.—yellow. Gel. lq.—gelatin liquefied. Bl.—bouillon. ac.—acid. I.—indol formed. M. c.—milk coagulated. L. m.—litmus milk. Gl. f. t.—glucose fermentation tube. Lc. f. t.—lactose fermentation tube. Sc. f. t.—saccharose fermentation tube. + yes. — no. :\|: coagulum formed, but is dissolved. ± acid formed, but is changed to alkaline. o.—no growth developed.

From a perusal of the foregoing, dealing with the bacteria isolated from the gastric mucosa of the cat, it will be seen that the species one may find in that situation are by no means constant. While the number of animals experimented with will not permit one to put this statement in a dogmatic form, yet from a study of the degree with which the more or less resistant species vary in their presence in this situation, it may be inferred that the bacteria and fungi found in the stomach are by no means constant factors, and that their presence in that organ is purely accidental, depending upon whether they are present or absent in the mouth of the animal, or in the food it ingested.

Again, by comparing the number of organisms grown on agar plates with mucus from the stomachs that were distended with food, and with mucus from empty stomachs of animals that were previously starved twenty-four hours, it may be conclusively stated that the number of micro-organisms present in a stomach containing food, even at the height of digestion, is very large, and infinitely greater than the number of micro-organisms that may be found in the stomachs of starved animals. While this conclusion may or may not hold true in the case of herbivorous animals, it may justly be applied to the carnivora and the omnivora.

What has been said above with reference to the presence or absence of these organisms in the stomach may apply, though in not so great a degree, to their presence or absence in any part of the alimentary tract.

From a study of the biochemic properties of the organisms isolated, it will be be seen that a large proportion of them have the power to produce acids in the presence of different saccharine substances, and that in their presence gas may be evolved in the different sugar-fermentation tubes, Finally, it will also be noted that all the organisms isolated from the stomach have the power to disintegrate various forms of complex organic materials which are used as foods by both man and animals. This disintegration, it will be noted, they accomplish by abstracting from the media in which they find themselves, substances which they need for their subsistence, and by adding to them, in turn, certain excrementitious matters, more often of a deleterious nature, the result of their own metabolic activities.

A Filter for Microchemical Analysis.

Filtration has without doubt been the least satisfactory operation in microchemical analysis, so much so that it is resorted to only in those cases in which it is indispensable through the impracticability of any other means of separation. The only known method that has been at all serviceable is that of Streng; and this is a slow method, and where large drops of liquid are to be filtered, not too effectual. Besides, not every man cares to bestow the time and patience often required in order to become really expert in the use of it. The modification of this method proposed by Hemmes, and recently cited by Professor Behrens in the second edition of his "Anleitung zur Mikrochemischen Analyse," removes the difficulties of the task; but it is still slow and does not allow the whole of either

the precipitate or the filtrate to be obtained, owing to absorption by the comparatively large amount of paper required.

In these rather delicate manipulations the personal factor of the operator counts for much, and it might be difficult to find a process that would be equally satisfactory to all. I have found the following, however, not only to be quicker and more efficacious than other methods of filtration, but also to be preferable in most cases to any of the other mechanical means of separation, particularly where it is required that the separation be complete.

A glass tube of about four millimeters inside diameter is drawn out as shown in the cross section. The reduction in the size of the tube should be as abrupt as possible, and the narrow portion of the tube should extend from fifteen to twenty millimeters from this point, with parallel sides and an inside diameter of about eight-tenths of a millimeter. The entire tube is eight or nine centimeters long, and both ends are rounded in the lamp flame.

From a piece of soft filter paper with smooth surface and long fiber a triangular piece is torn (not cut), two to two and a half centimeters long and one centimeter wide at the base. This is rolled between the fingers into a slightly tapering, cigar-shaped plug. It should be rolled dry, and rolled long enough to make it firm and even. If the paper is cut, and not torn, there will be a seam in it, and it cannot so readily be made tight. The plug thus formed is inserted in the small end of the tube from the outside and worked in by rotating the tube until from four to eight millimeters of the paper are within. The rest of the paper is then cut off a millimeter or two from the end of the tube.

After wetting the paper with distilled water, the small end of the tube is put in the midst of the drop of liquid that is to be filtered and the liquid sucked through the paper plug with the lips or a filter pump. The end of the tube is moved about through the drop meanwhile until every particle of the liquid is sucked through. The filtrate can be removed from the tube by a narrow pipette with capillary point, from which it may be distributed for further analysis. It will be observed that the entire filtrate has been obtained undiluted, the amount retained by the small, closely packed plug being insignificant.

The precipitate will be found to have gathered into a bunch about the end of the tube, and it may be washed with a drop of water at a time, drawing the water up through the tube. It can then be removed readily enough. A small portion of the precipitate will be drawn into the fiber of the paper, and in case the amount of precipitate is slight or for any other reason it is necessary to save every particle, the wash water is first removed from the tube with a pipette and a small drop of the proper solvent introduced. The small end of the tube is then pressed against a glass slip, and the solvent is blown out through the paper plug, dissolving and carrying with it the last trace of the precipitate.

The action of this filter can be modified at will by using a tighter or looser plug. Where necessary the projecting end of the paper may be left a trifle longer and just touched to the drop while the liquid is sucked up. In general it will be found preferable not to have the plug fit too tight, but to shove it further into the tube for fine precipitates. One can easily determine the proper adjustments in the course of a half hour's practice. Mouth suction is usually more

convenient than the filter pump, the actual process of filtration taking from ten seconds to a minute, according to the size of the drop. While the plug is being fitted there is time for the precipitation to be completed.

Barium sulphate precipitated in the cold was filtered by this means, so that no suspended particles could be seen in the filtrate with a power of two hundred. Calcium oxalate freshly precipitated in the cold gave a filtrate that showed no test for calcium with sulphuric acid. Metastannic acid formed by treating tin with nitric acid required boiling before filtering. The filtrate gave a doubtful, but certainly not decisive, test for tin with caesium chloride. A solution containing 6.66 per cent. of calcium chloride and 0.00394 per cent. of magnesium chloride (1 part Mg to 2400 parts Ca) was precipitated with ammonic carbonate and the magnesium readily detected in the filtrate as ammonium magnesium phosphate. The tests for time of filtration were made on the separation of cobalt as potassium cobaltous nitrite from an equal quantity of nickel.

GEORGE HUBBARD SAVAGE.

On Preparing Earthworms for Sectioning.

The method usually given to clear the intestine of the earthworm of sand and gravel, when preparing for sectioning, is to feed the animal with bits of filter paper or bread, which fill the alimentary canal, expelling all previously contained matter. This process takes considerable time and is a somewhat bothersome one to carry out, in view of which facts it is thought that the following simpler, and in its results equally good method will be found more satisfactory.

The principle of the method is to force a stream of fluid through the whole alimentary canal, with sufficient force to flush it and wash out all the contained sand, etc. The exact method followed was to first stupefy the worms by placing them in three per cent. alcohol for an hour, and then during the next hour raising the strength of the alcohol to six per cent. by gradual additions. This will stupefy them so that they contract only slightly when handled. Then with an ordinary injecting syringe some of the six per cent. alcohol was injected under gentle pressure into the anus. After as much as possible had been injected in this direction, the body of the worm back of the clitellum was pinched and rolled between the fingers, this serving to loosen the contents of the intestine and free it of the larger lumps. The canula was then introduced into the buccal cavity and a stream of fluid sent through the whole alimentary canal till it came out perfectly clear of all particles. Care must be taken at first in sending this stream through the body, as too much pressure is likely to injure the tissues. It is a good plan to roll and knead the body between the fingers while the stream is being started through, but after it is once started it runs very easily and more pressure may then be applied, thus making the cleaning very thorough.

When the fluid comes through clear the injection may stop and the animal be fixed in any convenient killing fluid. This method has given excellent results and its simplicity is its recommendation. RAYMOND PEARL.

University of Michigan, Zoölogical Dept.

LABORATORY PHOTOGRAPHY.

Devoted to methods and apparatus for converting an object into an illustration.

THE RAY FILTER IN LABORATORY PHOTOGRAPHY.

Every scientific worker who has ever had occasion to photograph colored objects realizes the difficulty of obtaining correct values of the various colors on the photographic plate.

Orthochromatic plates, though a distinct advantage, fail to register correct color values, and we must use a screen in connection with them to produce anything like satisfactory results. Screens of yellow glass are commonly employed for this purpose, and are quite satisfactory for many kinds of work. The screen of yellow glass intercepts the actinic rays of light, so that white or blue objects are not so badly over-exposed, as is normally the case. Everyone

BASILONA IMPERIALIS, DRURY.
PHOTOGRAPHED IN THE ORDINARY WAY.

knows that blue objects, even though dark blue, appear as if white in the photographic print, while light red usually appears very dark or black; perhaps to the eye the blue may seem as dark as, or darker than the red. A screen consisting of a cell having parallel surfaces and filled with a solution of bichromate of potash, is now used quite extensively, and is superior to a plain glass screen because the density of the solution can be varied to suit the operator and according to the needs of the subject. Bichromate of potash is said to absorb more actinic rays of light than any other substance.

I wish to contribute a few notes from my own experience in the use of a bichromate ray filter. Nearly a year ago, it was necessary to make for reproduction, photographs of several labels used upon sale packages of adulterated food products. This work fell to the writer. One label was of a dark red color, with a portion of the inscription in white letters; the remainder of the reading and several

ornamental scrolls were printed in black with fine lines. I tried ordinary plates and orthochromatic plates with various exposures, but could not make the black letters and lines on the red groundwork appear distinctly in the negative. By the use of the ray filter, however, with a long exposure on an orthochromatic plate, fairly satisfactory results were obtained; much better than it was possible to do without the filter.

But it is in photographing blue and yellow colors that this form of screen is of greatest value, and I consider it indispensable in photographing insects and flowers.

In making a series of life-sized photographs of moths and butterflies a few months ago, various methods were employed to bring out the color values as well as other natural characteristics. No gallery was at hand, but the greenhouse made an excellent substitute. The camera, with a long bellows, was placed

BASILONIA IMPERIALIS, DRURY.
PHOTOGRAPHED WITH RAY FILTER.

horizontally on one of the benches and the object pinned to a vertical board which had been covered with paper of the right color to make a suitable background. Common manila paper will do in many cases.

The accompanying illustrations show the Imperial Moth, *Basilona imperialis* Drury, as photographed both with and without the screen. The ground color of the wings is sulphur or lemon yellow, and the markings, though difficult to describe, may be designated, perhaps, as mauve or purplish brown. The specimen was a fresh one and the colors exceedingly brilliant. Both photographs were taken upon Carbutt's orthochromatic plates (sensitometer 27) and were developed with metol in the same manner. It will be noticed that the ordinary photograph is in sharper focus than the "ray-filtergraph". The operator should always re-focus after placing the screen in front of the lens. It is necessary to expose the plates five or six times as long as is usually done without the filter, and color sensitive plates should be used.

A few shadows were visible in these photographs. This was remedied in sub-

sequent work by inserting a spindle eight or ten inches long, into the board, and pinning the specimen to the end of the spindle.

I will only add that these photographs were made with the bichromate solution of the same strength as sent out in the cell by the manufacturers, and supposed to give the best average results. W. E. BRITTON.

Agricultural Experiment Station, New Haven, Conn.

PRACTICABLE PHOTOMICROGRAPHY.

By "practicable" the writer means simply possible and successful day in and day out—with all kinds of objects, tissues often miserably stained, thick sections lacking contrast, bacteria or the evasive *Amphipleura P.*, or even that *bête noir* of a generation gone by, the podura scale.

Photographic annuals, text-books, and even catalogues are sounding the praises of cheap and simple apparatus to the unwary victim, who begins to believe "any one can do it," and wastes time, money, etc., and then declares the whole thing a failure, and sticks to "diagramatic drawings" forever as the correct thing. So that after many years of work, with many failures and a few successes, the writer will not be thought over conservative if he advises only the *best* in the way of work room, apparatus, luminant, and technique.

Van Heurck may have done good work in photographing Diatomaceæ with a vertical camera, but Nelson has far surpassed him in the same field with a horizontal apparatus.

The writer possesses a vertical camera, made from Van Heurck's model, but it has only 420 mm. space possible between plate and ocular, so that various magnifications can only be obtained by high-power objectives or, what is worse, high eye-piecing. One recent experience will illustrate, the writer being called upon to photograph a specimen of "Hydatid mole" cut at 25 micra, poorly stained, where only high magnification (400 diameters) would satisfy the author of the article—and the syncitium cells alone well differentiated, the rest of the section a myxomatous tangle. High-power objectives and oculars would do nothing in such a case, but a 12 mm. .65 n. a. apochromat, with No. 3 projection ocular and 1800 mm. camera extension, gave a fair negative and was published.

While fairly good work has been and will be done by our best workers with comparatively poor apparatus, it does not pay in these days of nerve stress for a valuable worker to sacrifice himself trying to do the impracticable when it is not necessary, and an occasional success does not compensate for many sad failures, with loss of time, money and vitality.

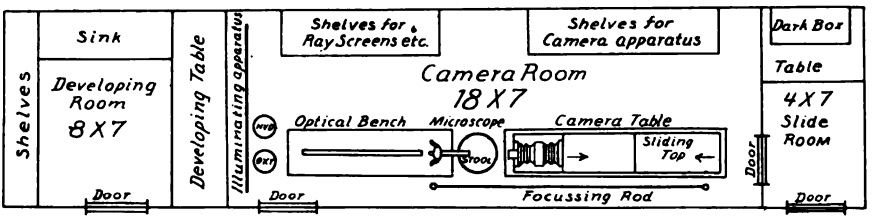
What the writer means by "best" will be explained most simply by a brief description of his own work place, apparatus, light, and technique as he possesses them.

Work place: a cellar with cement floor, brick walls, plastered ceiling, and running water; no vibration. The room or rooms (three in number) are arranged side by side, 30 feet long, seven wide; the first, plate-loading room, 4 x 7; next, camera room, 18 x 7; and last, the developing and printing room, 8 x 7, with

no communication except from plate-loading room to camera. The developing and loading room are usually combined, but we find it better to have separate rooms and avoid possibility of hypo dust, etc., an plates. The rooms are all built with hollow walls of dull black paper on a wooden frame, ensuring perfect ventilation and being light tight. The temperature does not vary 15° the year through, and no frilling or fogging of plates occurs because of excess of temperature.

As to apparatus, we have already given our decided preference for horizontal table and camera, so only need give brief description: two tables end to end, eighteen inches apart, one five feet long, carrying light, optical bench and microscope; the other six feet long, carrying only the camera, fastened rigidly together after proper alignment.

The optical bench carries illuminating medium—either Welsbach gas lamp or Oxy-Hydro Zirconium light, as the case may be, the first for low-power work and careful arrangement of microscope and object to be photographed, preliminary to high-power work and use of more powerful illuminant; the oxy-hydro light can be slipped on in place of the Welsbach, and in a minute we are ready for exposure.



PLAN OF PHOTO-MICROGRAPHIC LABORATORY.

While we have a very fine heliostat, most of our work is done at night for various reasons, and oxygen and hydrogen under pressure are all that are needed—far better than electric arc lamp for our work. Hard limes are used for some ordinary work, as the Zirconium is very expensive and breaks easily.

The optical part of the bench consists of the usual collecting lenses of Jena glass with light filters, cooling cell, iris diaphragm shutter, etc., all movable on the rail.

The microscope, which is used for no other purpose, sits on a sole plate which is rigidly attached to the table and is adjustable in all directions—English model, tripod foot, made by Watson & Sons, especially for this work, having mechanical stage and all possible improvements. Between this table and the camera table is a stool at the proper height for easy observation and manipulation of the microscope. The focusing rod runs at the left side, independent of the camera, the full length of the camera table, moving the fine adjustment of the microscope by means of a loose leather pulley running on a grooved wheel three inches in diameter, without the slightest strain on the microscope. The camera table proper is six feet long, with a sliding top seven feet long, to which the camera is fastened, running on its own rails—the whole top sliding smoothly on wooden runners to and from the microscope as needed, so that one can sit

down comfortably at the microscope, select the desired area to be photographed, then move the camera up to the tube of the microscope, clamp all rigidly together and proceed.

Before describing the camera, we will bring before our readers a simple piece of apparatus, possibly original with the writer, which has been found such a help that we are glad to publish it.

Running on the camera rails back of the entire camera is a wooden frame carrying an 8 x 10 photographic plate, exposed for a minute to white light with a white paper before it, in other words "fogged white," left undeveloped, giving a pure white surface with just enough grain to show details exquisitely. The top of the table carrying the camera is marked off carefully, showing various magnifications with different objectives, with and without oculars, and to use this screen the whole camera is closed up close to ocular of microscope; plate-holder, and inside diaphragms of camera removed, the screen moved to the mark showing desired magnification and the image projected upon it in far less time than it takes to write.

The only light in the room coming through the microscope, the section can be studied, rearranged if necessary, cells accurately measured, as the screen is ruled to mm., equality of illumination guaranteed, etc., then this screen is removed and the camera back with plate glass focusing screen slid in to the same mark, the final focusing done with achromatic focusing lens on plate glass focusing screen, plateholder substituted and exposure made—no failures, simplicity in every detail, with fullest assurance that one knows just what is being photographed, having seen its actual details projected on just the same surface as the sensitized plate which is to be made into the negative.

The camera proper is the large "Complete" horizontal one, made by Messrs. Bausch & Lomb, with several improvements kindly made at our suggestion, giving a camera extension from 400 mm. to 2000 mm., more than answering any demands than can possibly be made upon it.

The plateholder is perfect, and with a plate glass focusing screen cross-ruled to mm. can be used for the most critical work, magnifications being obtained with a fairly complete battery of objectives from 25 to 4000 diameters, using no higher than 2 mm. immersion objective and No. 6 projection ocular.

To the question arising in the mind of our reader: Why is such a camera extension necessary? we reply simply that high magnifications (all over 200 diameters) of some objects can only be obtained by the use of low-power (12 mm. and lower), objectives of best n. a. with long camera extension, for in photomicrography "depth of focus" or "penetration" means everything, and as this valuable quality (absolutely necessary in sections over 5 micra thick) decreases with increase of n. a., we must compensate by special technique in other ways.

Objectives, condensers, and technique the writer must perforce keep for another issue of the JOURNAL.

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Journal of Applied Microscopy.

L. B. ELLIOTT, EDITOR.

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The majority of our subscribers dislike to have their files broken in case they fail to remit at the expiration of their paid subscription. We therefore assume that no interruption in the series is desired, unless notice to discontinue is sent.

A CORRESPONDENT suggests the establishment of a question department, where questions may be asked and answered, either by the editors or by our readers. We shall be very glad to do this, and, as we have previously stated, will undertake to transmit replies by letter to the inquirer as soon as received, publishing those which seem to be of general interest. Those having difficulty in finding a process or apparatus for any particular work may receive practical aid by sending in an inquiry. Inquirers' names will not be published. Answers will be published over signatures by permission.

* * *

The battle of the educator in the effort to improve school administration and to place the conduct of school affairs on an economical and business basis, is an arduous one. In New York State, where the supervision of the secondary schools has, for a number of years past, been under the care of the Regents of the State University, and where thousands of dollars have been saved to the taxpayers, and where through a systematic coördination of school affairs privileges, apparatus, libraries, and improved courses have been secured, where they would have been impossible without such aid, local jealousy has become such a factor that a recent bill before the legislature intended to still further increase the effectiveness of the Regents' administration failed of support even from those whose experience had shown the wisdom of State supervision.

* * *

The JOURNAL has been referred to as "A journal of work, for workers, by workers." We could not have coined a phrase more expressive of the aims of the publishers. We welcome the productions of workers and suggestions for new fields of work in applied microscopy.

* * *

Contributions so far received for the department of laboratory photography give promise of making it one of interest and practical aid to users of the microscope. The spontaneous expressions which we have received regarding it indicates a general desire for such information, and in many cases for elementary instruction in photographic processes. This we shall attempt to supply as occasion permits, giving methods which have been thoroughly tested and found practical for the purpose, even at the risk of repeating something which may have appeared in the photographic press. Biologists are not necessarily photographic experts as well, and, especially among teachers, have little time for outside reading. Hence we justify ourselves in the reproduction of reliable information in this direction.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to
Charles J. Chamberlain, University of Chicago,
Chicago, Ill.

REVIEWS.

Belajeff, Wl. Ueber die Cilienbildner in den spermatogenen Zellen. Ber. d. deutsch. bot. Gesell. **16**: 140–144, pl. 7, 1898.

In this short paper the writer shows the relation between centrosome and cilia in the development of the spermatozoids of *Gymnogramme sulphurea* and *Equisetum arvense*. In Gymnogramme, two centrosomes (the blepharoplasts of Webber and others) appear at opposites poles of the nucleus of the grandmother-cell of the spermatozoid. The division of this nucleus is not accompanied by a division of the centrosome, and consequently each of the resulting spermatozoid mother-cells receives only a single centrosome. The centrosome, originally spherical, now becomes elongated into a ribbon-like band lying alongside the nucleus, and the numerous cilia arise from the peripheral portion of the band.

In *Equisetum arvense* the development is the same, but here the writer was able to see that the elongated band was differentiated into a series of intensely staining granules, each of which gave rise to a single cilium. The spherical organs which give rise to the band are regarded as genuine centrosomes, and Belajeff would homologize with them the blepharoplasts of Webber (Zamia) and Shaw (Marsilea and Onoclea), and also with the cilia-forming centrosomes of Hirase (Gingko) and Ikeno (Cycas). He would also homologize the cilia-forming band with the "middle piece" of the animal spermatozoan as described by Hermann for the Salamander. C. J. C.

Molisch, H. Ueber Zellkerne besonderer Art. Bot. Zeit., **57**: 177–190, pl. 17, 1899.

During his investigations upon the latex and mucilage of various plants, the writer met three peculiar types of nuclei, which he describes in the present paper:

First. Vacuolated nuclei (*Blasenkerne*). These nuclei have a sap vacuole of extremely large size as compared with the size of the nucleus. Such nuclei have hitherto been unknown in plants or in animals. At first it was thought that the nucleus was lying free in the large sap vacuole, but more careful observation showed that the large vacuole lay between the body of the nucleus and the nuclear membrane. These nuclei were found in the latex of *Musa*, *Humulus*, and various Aroids.

Second. Filamentous nuclei (*Fadenkerne*). This type of nucleus was found in the mucilage of *Lycoris* and other members of the Amaryllidaceæ. A fresh drop of mucilage shows great numbers of nuclei of various forms—round, oblong, pointed, and filamentous. These latter the writer calls "Fadenkerne," and the name is certainly appropriate since some of them with a breadth of only 0.1μ were over 1500μ in length. A series of stages shows that the filamentous nuclei are originally spherical and only gradually attain the elongated form. The

occurrence of such nuclei, as well as the presence of numerous nuclei in large cells, like laticiferous vessels and coenocytes, favors the view that the sphere of activity of the nucleus is a restricted one, and that multiplication and modification of form are adaptations to meet a physiological need.

Third. Giant nuclei (*Riesenkerne*). These were found in Aloë. In a drop of mucilage of *A. saponaria* nuclei were found with a length of 82μ and a breadth of 40μ, also filamentous nuclei with a breadth of 7μ and a length of 825μ. Some of the nuclei have an exceedingly firm nuclear membrane measuring in some instances as much as 1μ in thickness. The largest nuclei yet described in plants are found in *Chara*, and in the embryo-sac of some of the Liliaceæ. Nuclei in the embryosac of *Fritillaria imperialis* sometimes reach a diameter of 50μ. C. J. C.

Stansfield, F. W. On the Production of Apospory by Environment in Anthyrium Felix-fæmina, var. unco-glomeratum, an Apparently Barren Fern. Jour. Linn. Soc. Bot., **34**: 262–268, 1899.

The writer has, at different times, succeeded in raising plants by apospory in eight different ferns—four forms of *Polystichum angulare*, one of *Lastrea paleacea*, and three of *Athyrium filix-fœmina*. In all cases it is noted that prothallia are produced with much more ease from young fronds than from adult ones. If the first fronds from a prothallus are pinned down, the edges rapidly develop into prothallia. The aposporous production of prothallia is regarded as an atavic trait, and the suggestion is made that apospory could be induced in many, and perhaps in most, ferns by careful treatment. The fact that Mr. Druery, a few years ago, succeeded in producing apospory in *Scolopendrium vulgare*, apparently a most unlikely form for such an experiment, on account of the smooth, strap-shaped fronds, would indicate that the suggestion is not unfounded. C. J. C.

Lecture on the Evolution of Plants. By Douglas Houghton Campbell, Ph. D., Professor of Botany in the Leland Stanford University, Junior. Pp. viii., + 319, figs. 60. N. Y., 1899. The Macmillan Company.

From the point of view of evolution plants have never excited such general, nor even scientific, interest as animals. The reason is sufficiently obvious. The phylogeny of the animal kingdom has a closer relation with the descent of man. Besides, the most striking illustrations in favor of the theory of evolution have been taken from zoölogy rather than from botany, and have become fixed in the popular mind. The author has performed a valuable service in presenting to teachers and general readers a clear statement of our present knowledge of the evolution of the vegetable kingdom. Dr. Campbell is well qualified, both by training and by predilection, to speak with authority, having made noteworthy contributions to the subject by his own investigations, though he modestly claims to have done little else in this volume than to compile the researches of others. The only books in English, dealing with the evolution of plants are adapted to the needs of special students mainly, or treat of particular aspects of the subject. This simpler presentation of the more important facts of plant evolution will consequently be welcomed.

After a chapter upon the general conditions of plant life, the author discusses the vegetable kingdom, group by group, usually devoting a chapter to each sub-

kingdom. A brief description of the principal structural features and of the mode of reproduction is given, then the affinities with neighboring groups is pointed out. A summary of the conclusions reached, together with a diagrammatic representation of relationships, is found at the end of each chapter. The last chapters deal with geological and geographical distribution, animals and plants, influence of environment, summary and conclusion.

The language throughout is clear and simple, and the descriptions are quite free from technical terms. While some of the figures would be improved if drawn on a larger scale, they are as a rule quite distinct. The work would make an attractive text-book on a subject which receives very little attention in the colleges and universities of this country. CHARLES WRIGHT DODGE.

Campbell, D. H. Studies on the Flower and Embryo of Sparganium. Proc. Cal. Acad. Sci., 3rd ser., I: 293–328. Pl. 46–48. 1899.

Prof. Campbell published a preliminary note on *Spargahium* and *Lysichiton* in the *Botanical Gazette* of March, 1899. The present paper treats the subject in greater detail and adds some observations upon floral development, the embryo and the affinities of the genus. The principal features are the following: in *S. simplex* the ripe microspore contains but one generative nucleus, but there is regularly present a structure which probably represents a vegetative or prothallial cell. After fertilization, the antipodals multiply until they often form a mass of over 150 cells, which doubtless function as endosperm. In the embryo there are three primary transverse segments, the terminal one of which gives rise to the cotyledons stem apex, and the plerome of the root. The other tissues of the root come from the middle segment.

The writer concludes that so far as any comparative embryological study has been made, it would indicate that *Sparganium* is more nearly allied to the Gramineæ than to any other family, unless, possibly, the Pandanaceæ.

C. J. C.

Lloyd, F. E. The Comparative Embryology of the Rubiaceæ. Bull. Torr. Bot. Club. 8: 1–25. Pl. 1–3. 1899.

The paper is the first of a series intended to contribute to a better knowledge of phylogenetic relationships between the families of the Rubiaceæ and Dicotyls in general. It is the purpose of the author to discuss morphological facts from a physiological standpoint, and in this case he has shown the source and method of supplying nutrition to the important cells concerned in reproduction from megaspore to embryo. *Vaillantia hispida*, one of the Galieæ, develops a multicellular archesporial tissue in a nucellus covered by a single, peculiar integument which makes itself known by forming the micropyle. Into this micropyle the successful megaspore migrates, completely separating itself from the archesporial tissue in which it was developed. The mature embryo-sac, however, thrusts a highly developed antipodal back among the deserted megaspores. The endosperm nucleus is very large and at once takes a position close to the egg. Coincident with the development of the embryo a large suspensor, with cells clustered like a "bunch of grapes," becomes conspicuous in the region of the micropyle, but fades away with the appearance of the cotyledons. Meanwhile starch is accumulating in the integument and endosperm, and this with cellulose of the thickened

walls constitutes the food supply of the mature fruit. The megaspore derives its nutrition from the walls of the micropyle; the mature embryo-sac from adjacent cells and especially from the archesporial tissue through the basal antipodal. The endosperm from the first maintains a position at least partially surrounding the egg and embryo and encroaches deeply upon the nucellus; the suspensor absorbs the micropylar region and passes the nutrition on to the embryo; the embryo itself at last encroaches upon the endosperm, and through the branch of the general conducting system which ends in the chalazal region, starch and cellulose are brought to wait the further need of the embryo. The paper is well written and the plates are excellent. JNO. E. WEBB.

Klebs, G. Zur Physiologie der Fortpflanzung einiger Pilze. Jahrb. f. wiss. Bot. **33**: 513–593. 1899.

This article is one of a series, the earlier numbers treating of various algae, a later one of *Sporodinia*, while the present paper concerns itself with *Saprolegnia*. Throughout the series the object has been to determine what chemical and physical factors affect the mode of reproduction. Dr. Klebs finds nourishment to be the ruling factor regarding the formation of sporangia. A mycelium will vegetate indefinitely if well fed, but if transferred to a poor medium, as water, will immediately produce abundant zoöspores. Then by determining that degree of concentration at which growth gives way to reproduction by zoöspores, an idea of the relative nutrient values of the various foods may be obtained. Albumins are the most favorable among organic substances.

By varying the nutrient value of the medium, Dr. Klebs could, at will, produce sterile hyphæ, hyphæ with rudimentary sporangia, sporangia with zoöspores which are not extruded, or functional zoöspores. The formation of zoöspores can be completely stopped in several ways: (1) by rich nourishment, (2) by inhibiting by-products, e. g., ammonium carbonate, (3) by very gradual starvation, (4) by poisons, (5) by solutions of strong osmotic pressure, (6) by the absence of water. Water must bathe the tips of the hyphæ. Oxygen, temperature and light are of but little significance.

Sex organs develop if the fungus be placed in conditions of incipient starvation, which are such as to preclude the formation of zoöspores, e. g., on gelatine. Certain inorganic salts seem indispensable to the formation of sex organs, e. g., potassium phosphate. By properly regulating the amount of this salt the following conditions may be obtained: sterile hyphæ, hyphæ with oögonia only, hyphæ with oögonia and few antheridia, hyphæ with oögonia and antheridia, the latter bearing tubes.

It appears that the oögonium by a kind of chemotropic influence induces the formation of the antheridium, a view held by De Bary.

There is nothing to indicate any internal tendency toward an alternation of generations, although, in nature, the conditions of nourishment are usually such that one form of reproduction follows another.

Gemmæ are regarded as specialized portions of hyphæ whose function it is to tide over hard times or to preserve life in conditions under which the other modes of reproduction are unavailable. They have no phylogenetic significance.

F. L. STEVENS.

Strasburger, Eduard. Ueber Reduktionstheilung, Spindelbildung, Centrosomen und Cilienbildner im Pflanzenreich. 8vo. Pp. XX+224. 4 plates. Gustav Fischer, Jena, 1900.

The literature of the reduction division, spindle formation, centrosomes and cilia-forming organs has been accumulating so rapidly during the past few years that investigators were beginning to feel quite keenly the need of a reliable summary of the more important papers. It is extremely fortunate that Strasburger, the leader in cytological investigations, has undertaken the work and has presented the results in a masterly way, which will make the book a necessity to all who are engaged in cytological research. The volume contains a brief, judicious summary of these subjects up to August, 1899. It is more than a summary, for the author has given his conclusions drawn from a renewed study of the literature, and has also taken this opportunity to present his own most recent researches upon these subjects.

In introducing the subject of the reduction division, the statement is made that the existence or non-existence of a reducing division has not yet been established either for plants or animals. After presenting the evidence both for and against a reducing division, he concludes that in both the nuclear divisions concerned in the formation of spores from spore mother-cells the splitting of the chromosomes is longitudinal and that consequently there can be no reducing division. The peculiarity of the first nuclear division which follows the numerical reduction of the chromosomes lies in the fact that the chromosomes very soon undergo a second longitudinal splitting. The second nuclear division which follows the numerical reduction merely distributes the chromosomes which are already marked out when the first division occurs. In the Bryophites and most of the Pteridophytes the numerical reduction of the chromosomes occurs long before the process of fertilization, but in the heterosporous Pteridophytes the two processes are much less widely separated, and in the flowering plants reduction and fertilization come very close together. This nearing of the reduction of chromosomes to the process of fertilization is plainly a derived condition caused by the reduction of the gametophyte. The writer still regards the reduction of chromosomes as a phylogenetic phenomenon which is not the cause but rather the result of fertilization, the reduction bringing about a return to the ancestral number of chromosomes.

Nemec's recent investigations led him to believe that the method of spindle formation in vegetation cells differs essentially from that in spore mother-cells, in the former being bipolar from the start and in the latter originating as a multipolar structure. The author objects to this distinction because he believes that the two forms intergrade. In root tips of *Ephedra major* he finds that in the early prophase of division a layer of delicate kinoplasm is formed about the nucleus, and that this layer soon collects at opposite poles of the nucleus, where it appears as a pair of caps, the filamentous nature of which is easily recognized. As the nuclear membrane disappears, threads grow into the cavity, some of them becoming fast to the chromosomes and others forming continuous threads from pole to pole. Since the threads have the same origin and show the same reaction to reagents, the terms mantle fibers and central fibers are not considered necessary.

In regard to centrosomes, the conclusion is reached that they are absent from the higher plants, although it is conceded that it would be unscientific to assert that their occurrence here is impossible. He is inclined, at present, to attribute to the kinoplasm of the higher plants all of those functions which it elsewhere shares with the centrosome.

The existence of the blepharoplasts, which are characterized as specialized masses of kinoplasm, should not be regarded as evidence in favor of a general occurrence of centrosomes in higher plants. While acknowledging that it would be hard to doubt the centrosome nature of the organ which gives rise to the tail of the animal spermatozoan, he does not deem it necessary to assume that the bodies at the base of cilia in animals are also centrosomes. The evidence does not point to the existence of similar bodies at the base of the cilia of plant swarm spores and gametes. C. J. C.

MacBride, Thos. H. The North American Slime Moulds. 8vo. Pp. XVII+ 269. 18 plates. MacMillan, N. Y., 1899.

Those who have used Prof. MacBride's monograph on the Myxomycetes of Eastern Iowa, will welcome the more extensive account furnished by the present volume, which gives descriptions of all species of Myxomycetes hitherto described from North America, including Central America. It is interesting to note that the author uses the term Myxomycetes, in preference to Mycetozoa. The introduction gives an account of the habit, habitat and life history of the group and also a discussion of the nomenclature. Directions are given for collecting, preserving and mounting specimens.

The aethalioid forms are regarded as the most primitive, while the isolated sporangium with its capillitium is the highest expression of Myxomycetan fructification, reached by successive differentiations from the simple plasmodium. The artificial keys follow this sequence. As in the previous monograph, the keys are clear and the descriptions are accompanied by a full synonomy. The plates are well drawn and should enable the student to recognize in his preparations the structures which the figures are intended to illustrate. C. J. C.

MacMillan, Conway. Minnesota Plant Life. 8vo. Pp. XXV+ 568. 4 plates and 240 figures. Published by authority of the Board of Regents for the people of Minnesota. 1899.

This volume is peculiar in several respects: it does not profess to be a textbook and yet the greater part of its 568 pages can be read with appreciation in the district schools; while written in popular style, almost entirely free from technical words, it is unusually free from inaccuracies, unless, even in a popular account, it be deemed an inaccuracy to relate as a fact only one side of a question which many botanists do not yet regard as settled, e. g., the author's explanation of colors of plants; a further peculiarity is that, while plants are presented in taxonomic order from the lowest up to the highest, the account is not a dreary enumeration of tribes and cohorts, but is a literary presentation which can be read. It is worthy of note that the cryptogams receive a fair amount of space, 152 pages being given to these forms. Since the book owes more to the author's personal familiarity with the Minnesota flora than to other books, it is not to be wondered at that the ecological relations of plants are made quite prominent.

The numerous figures will enable the average observer to recognize in the

field the plants described in the text. A large number of excellent photographs gives a good idea of Minnesota landscape and flora. C. J. C.

Trow, A. H. Observations on the Biology and Cytology of a New Variety of Achlya Americana. Ann. Bot. **13**: 131–179. Pl. 8–10. 1899.

One of the oldest of controversies in botany is regarding the existence of true sexuality among the Saprolegniaceæ. Away back in the fifties, Pringsheim was opposed to Cornu and De Bary. In the eighties, Pringsheim asserted that he saw amœboid spermatozoids develop in the antheridia and fertilize the oösphere. This view was strongly opposed by Zopf, but was reasserted by Pringsheim. De Bary and Marshall Ward contributed to the argument and the literature grew. These were in the days before cytology reigned. During the last six years the subject has been under constant discussion, Trow asserting that there is a true fertilization while Hartog denies its existence. In the present paper Trow asserts that in *Achlya* the young oögonium contains many nuclei while the oöspores each have one only. He says that in the development of the oöspheres the nuclei divide indirectly and the supernumerary nuclei degenerate. The one functional nucleus that remains fuses with one male nucleus derived from the antheridial tube. He thus, in his most recent work, reaches the same conclusion that he announced in the earlier papers, viz., that a fertilization does exist in this group of fungi.

F. L. Stevens.

CYTOLOGY, EMBRYOLOGY, AND MICROSCOPICAL METHODS.

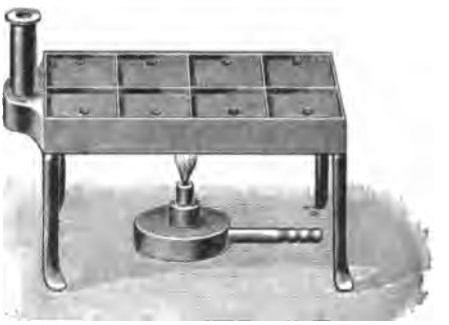
Agnes M. Claypole.

Separates of papers and books on animal biology should be sent for review to Agnes M. Claypole, Sage College, Ithaca, N. Y.

CURRENT LITERATURE.

Piorkowski. Ein neurer heizbarer Färbetische. Deutsche Med. Wochenschrift, pp. 318, 1898.

The author worked especially in staining tubercle bacilli, and spore and flagella preparations, and constructed a contrivance for definite heating during the process of staining. The arrangement, as seen in the figure, consists of a four-sided, shallow, box-shaped, closed water-bath with four small feet. It is heated by a very small gas flame and the steam escapes through a small chimney. The surface of the water-bath contains eight four-sided depressions, each for a cover-glass to be filled with different stains. One filling of



the bath lasts for about fifteen minutes and spores stain in ten. This apparatus is particularly good for staining flagella. The best results followed with Loeffler's logwood solutions, Bowhill's orcein solution, when very gently treated with extract of galls for ten minutes, washed with water and alcohol, and counter stained with anilin-water-malachite-green. A. M. C.

Unger, E. Beiträge zur Anatomie und Physiologie der Milchdrüse. Anat. Hefte., pp. 151–225, 1898.

The author studied milk glands during lactation in guinea pigs, cats, dogs, and rabbits, removing about one cm. of the gland by aseptic operations. Also the freshest obtainable human material was used. The gland was cut with the sharpest knife possible into very small pieces and these were fixed in alcohol sublimate, .5 per cent. chromic acid, Flemming's solution, 10 per cent. nitric acid, with after treatment in potassium bichromate. At first formol was used effectively by putting a piece of one cm. into a one to two per cent. solution for one or more days, then cutting it in pieces one mm. thick and laying it in osmic acid for one or two days. This process seems to have an adverse effect on the osmic acid process. The small fat drops are no longer clearly visible. The largest are swollen and their contour lacking in sharpness. A ten per cent. solution gave much clearer results, and still better ones are obtained with ten per cent. nitric acid (two hours), following this with five per cent. bichromate of potash or osmic acid (.5 per cent.). Flemming's fluid was only moderately good because of lack of penetration. No advantage came with using a special osmic acid solution made as follows: one per cent. osmic acid 10 parts, two per cent. acetic acid 50 parts, distilled water 40 parts. Very good preparations came from tissue that had been left in boiling water or alcohol for one minute. Marchi's osmic acid gave the best results, tissue being kept in very small pieces for two to five days in Müller's fluid, then into a mixture of two parts of Müller's fluid and one of osmic acid renewed daily. Washed out in water, hardened in absolute alcohol (3 days), the tissue is embedded in celloidin or paraffin, the whole process being carried on in the dark. Continued stay in the alcohol is an advantage because penetration is slow and difficult. Specimens fixed for an hour in ten per cent. formol are cut on the freezing microtome as check preparations. Osmic acid will differentiate the tissue more completely on the use of reduction fluids; twenty per cent. formic acid serves very well if the sections are left in it for a day and counterstained with safranin. Xylol balsam mounts are not permanent and glycerine unsatisfactory, but those mounted in colophonium benzin were as sharp after six months as before. A. M. C.

Nachtrieb, Henry F. Permanent Preparations in Hermetically Sealed Tubes. Science N. S. **10**: 771-772, 3 text-figs., 1899.

A simple method is given for preparing specimens for exhibition in the museum or for class demonstration.

Glass tubing, wide enough to admit the specimen, is selected, and the end sealed with or without a foot. It is then filled with 70 per cent. or 80 per cent. alcohol and the specimen worked down into the tube, after which nearly all the alcohol is poured off unless the specimen is of delicate structure, when enough alcohol is left to cover it. The tube is now heated and drawn out to a point at

some distance from the object and broken off at the narrow neck, leaving a small opening through which to fill the tube. A funnel with the end drawn out small enough to fit the opening left in the tube is used and the tube is filled up to the shoulder or a little above. The opening is then sealed in the Bunsen flame, care being taken to get the tube out of the flame before the expansion of vapors becomes too great. The smaller the open neck, the more easily the sealing will be accomplished. Flemming's mixture of alcohol, glycerine, and water is recommended as it preserves the specimen and is not readily vaporized. A strip of milky or black glass about the diameter of the tube will bring into relief objects that are to be viewed only from one side. E. M. B.

Haeker, V. Praxis und Theorie der Zellen- und Befruchtungslehre. Jena, 8vo, 260 pp. 137 figs., 1899.

The author has in this volume made a most useful introduction to cytology, by presenting a series of practice lessons on the cell, nucleus, karyokinesis, ovum, spermatozoan, maturation, fertilization, etc. Wide experience as a teacher has given him knowledge of the material best suited for class purposes, and each lesson gives the special methods best adapted for the particular subject under consideration. The historical and theoretical points of interest are also briefly included. Careful figures and references add to the value of the work, making it in every way one helpful to the teacher and student. A. M. C.

Schaffer, Josef. Zur Kenntnis der glatten Muskelzellen, insbesondere ihre Verbindung. Zeit. f. wiss. Zoöl., **66**: 214–268, 2 pls., 1899.

The author had especially in mind the determination of relations between the cells and the presence or absence of the intercellular bridges of Kultschitzky. He began his studies with fresh preparations from the umbilical cord, gut, and urinogenital tract of man and the domestic animals. The existence in these preparations of a partly fibrous connective tissue between the muscle cells was clearly demonstrated. The margins of the muscle cells were entirely smooth, and the apparent transverse bridges are due to folds in the connective tissue or to fibrous structures. A series of experiments with fixing reagents showed great varieties of reactions; the same appearance not always following treatment of muscle by a given fluid. The usual effect is to give the cell a toothed instead of a smooth contour, thus necessitating careful interpretation of sections. Stains differentiating muscle and connective tissue were necessary, and picric acid and acid fuchsin were found satisfactory. By comparing many preparations made in this way, a delicate perforated sheet of connective tissue was seen to exist between muscle fibrils. This has in reality a frame-like structure, but in optical section appears like a network. The "intercellular bridges" of Kultschitzky and Barfurst are artificially produced by breaking up this connective substance, and hence the contradictory reports as to the presence or absence of these structures are explained. A. M. C.

Smith, S. Note on the Staining of Sections while Embedded in Paraffin. Jour. Anat. and Physiol. (34), N. S. **14**: 151–152, 1899.

The writer while preparing sections for class purposes noticed that a ribbon of paraffin sections floated out on hot water, and left there was faintly stained by the presence of an accidental drop or two of methyl violet left in

the water. It was found that the parts staining were cartilage, and the inference is clear that paraffin does not penetrate that tissue. Experiments proved that the following steps gave the best results. Tissues were embedded and cut in the ordinary manner. Sections were then placed in ribbons on the desired stain in a flat vessel, room being left for the sections to stretch out. The vessel was covered to prevent evaporation and keep out dust, and left in a warm place till the sections were perfectly flat, and then kept at an ordinary temperature. Any stain chosen was allowed to act for twenty-four hours, more or less, according to the penetrative power of the stain. Stain was then poured off, allowing the sections to remain flat on the bottom of the vessel. Washing with water, added slowly, to remove all excess stain, and decolorizing by ordinary methods if necessary followed. Mounting sections on slides, drying, and removing paraffin with xylol or turpentine, and placing in lavendar or balsam, completed the steps. Twelve hours was the most favorable time of staining, and any kind of stain, direct, indirect or double, gave equally good results. The advantage of this process is that thinner sections can be given to students without so much risk of injury.

A. M. C.

Colquhoun, W. Some Experiments on Bone, with Method of Demonstrating the Canaliculi. Jour. of Anat. and Physiol. (34), N. S. 14: 84–89, 1899.

While a student in Glasgow University, the author began experimenting on bone, in order to obtain some more definite knowledge of its manner of nutrition and the arrangement of the canaliculi. He wished to pass stains through the bone without previous decalcification, so that only the soft parts would be stained, and those by natural channels. The experiments began by soaking thin slices of bone in various staining fluids, but this proved fruitless. By boring holes in the cancellated bone of the head of the femur and filling these with stain while the bone remained in the air, the color (picro-carmine, eosin, safranin, etc.) was found to diffuse through areas round the holes. These areas were cut into slices, dehydrated, cleared in clove oil, and passed through benzole Canada balsam, and put in stick balsam and left in a drying oven until the balsam was perfectly hard and fit for grinding. The sections were then ground and showed that the stain had passed through the canaliculi and all of the nuclei of the bone corpuscles were stained. Outlines of canaliculi were, however, very faint.

Glass tubing was next arranged in lengths of twelve feet on a wall; a bone with the head sawed off and the medullary cavity cleaned out and one end corked was connected with the glass tube by means of a wide rubber tube. The periosteum was removed, and any holes visible on the outside of the bone plugged with wooden plugs. The tubing was then filled the whole length with stain, to which a little antiseptic had been added. The bone being in a dry room dried, and as this occurred the stain was drawn in to take the place of the evaporated moisture. After about a month all the nuclei of the bone cells were found stained, also the lining membrane of the canals; the bone matrix was quite unstained and canaliculi faintly outlined.

Articular cartilage was never stained to any extent by fluid acting from the inside, but readily so from the outside; the natural conclusion from this being

that nutrition probably takes place from the synovial fluid, and not from within. Further experiments were made with fixing fluids of good penetration, followed by a fluid that would form a precipitate, so as to bring out the canaliculi. Three per cent. bichromate of potash was satisfactory, slices of bone being permeated in a few days. After grinding one side down until fairly smooth, the slice was put in one per cent. silver nitrate and left in a dark place for a week or two. The slice was then put in hard balsam smooth side down, and left to dry. Grinding showed that the silver nitrate had permeated only a few layers of the smooth side. When these were reached, the balsam was heated and the section quickly turned; the grinding was then continued until but a single layer of corpuscles remained; in their preparations canaliculi and lacunæ were all black. Mercuric chloride can be used as a fixer with ammonium sulphide as a precipitant; the only necessaries are a good permeable fixer and a fluid that forms a precipitate with it.

Many points indicated clearly to the author that there is a continuity between the lining membrane of canals, spaces, canaliculi, and lacunæ, so that the apparent "processes" of the corpuscle are hollow prolongation of the capsule; sometimes cross sections can be seen showing the cut ends. The nutrition of bone seems to depend on the need for fluid by the protoplasmic lining of the system of passages. No evidence was seen of permanent solid processes of the cells, so that canaliculi have more the character of tubes and are not to any extent solid. Another method besides grinding may be employed to obtain thin sections. A decalcifier which will not dissolve the precipitate can be used and sections cut of the tissue, so that can be obtained in both ways, giving practically similar results.

A. M. C.

Hardy, W. B. Structure of Cell Protoplasm. Part I. The Structure Produced in a Cell by Fixative and Postmortem Changes. The Structure of Colloidal Matter and the Mechanism of Setting and Coagulation. Jour. of Physiol., **24**: 158–210, 1899.

The author first gives a careful historical review of the work done within the last forty years on protoplasmic structure, since Brücke's first deduction that some organization must exist for the expression of the many complex phenomena of cell life. The paper is divided into three parts: (1) The nature of the structure produced in solid and liquid colloids by the action of fixatives. (2) The production of structure by *sub mortem* and *post mortem* changes in the animal cell. (3) The application of the facts and principles set forth in the first two sections to the appearances seen in the cell substance, dead or dying (but unfixed) and fixed.

In the first part the author discusses experiments on colloid substances such as gelatin and white of egg. He found that treating these with reagents, as one per cent. osmic acid in solution and vapour, one per cent. potassium bichromate, saturated corrosive sublimate solution in .6 per cent sodium chloride, formalin, potassium sulphocyanate, and heat. Two distinct methods of examination were used, microscopical observation and pressure experiments. The first consisted in films, preparations by teazing and paraffin sections (.6 to 1 μ.). Objects were examined in air, water, alcohol, and Canada balsam. As a result of these experiments the conclusion is that reagents form from these homogenous substances known as colloids, certain insoluble modifications in which solid par-

ticles have been separated in large molecular aggregates and arranged in a coarse network, having in its meshes a fluid substance. Microscopic preparations resemble almost exactly the protoplasmic network described in cell structure. In some cases the reagent is partly miscible with the colloid substance, and then the reaction is similar in kind but less in degree. Corrosive sublimate reacts in this way upon gelatin. In general, however, reagents that have any action at all upon colloid substances change the structure to one differing, in most cases in kind, in others in degree, from the initial structure. It is hence inferred that structures seen in cells after fixation are due to an unknown degree to the action of fixing reagents. This assumption is based on the almost demonstrated fact that protoplasm is of a colloid nature.

For the second part of these studies the author used the orbital glands of young dogs and cats. Material was preserved with absolute alcohol, with vapour of osmic acid, and with chromic acid. By the use of free-hand sections pieces with extremely thin edges were obtained. In all cases a relatively solid framework is formed containing liquid substance between the meshes. Clotting and coagulation is regarded as the same process, and this is shown to occur without chemical change, as in the case of gelatin, or with chemical change. In the latter case it can be caused by heat, by ferments, by chemical reagents. The last kind involves the changes known as fixation, while somewhere in the three classes will appear coagulation. In fixation all or part of the solid matter may be separated as a framework. The author's experiments lead him to believe that the alveolar structure or network seen in cells is due to the separation of the solid constituents of protoplasm from the liquid. Dependent on the degree of solubility of these solids in the reagent a complete network is formed or a less complete granular condition results. By treatment with increasingly dilute alcohols these granules can be made to swell and reduce the protoplasm between them to a minimum, till it appears as a fine network. If the process has not been carried too far (below 40 per cent. alcohol) increasing strengths will shrink the granules to their normal size and an apparent increase in amount of intergranular substance will result. There is conclusive evidence that the strands are directly continuous with the protoplasm immediately round the nucleus.

In the third part of his paper the author points out three logical inferences to be drawn from his previous studies. That a regular geometrical figure may be conferred on cell protoplasm by the presence in it of secretion masses and especially by *post mortem* swelling of secretion masses. That so far as can be judged by control experiments with colloids of known character, structure is produced by the changes in cell substance produced by fixation. That processes of dying, since they partake of the nature of coagulation, also produce such radical changes.

A. M. C.

NORMAL AND PATHOLOGICAL HISTOLOGY.

RICHARD M. PEARCE, M. D.

Harvard Medical School, Boston, Mass., to whom all books and papers on these subjects should be sent for review.

Buttner, F. Investigations into the Rôle of the Peritoneal Epithelium in Inflammation. 2 plates. Beiträge zur Path. Anat. und Allgem. Path., **25**: 3, 1899.

The object of the experiments described in this paper was to prove that the epithelial cells do not become fibroblasts by metamorphosis and that in the regeneration following inflammation the epithelial cells do not originate from fibroblasts.

In the rabbit adjacent portions of the peritoneum were sewed together. Cultures of the *staphylococcus* albus were injected into the peritoneal cavity of guinea pigs, as was also "*Silberlösung*."

In another animal the two layers of the tunica vaginalis of the testicle were brought together by one long suture passing through skin and testicle.

Experiments on pleura were unsuccessful owing to technical difficulties.

The tissues were preserved by the ordinary methods.

The epithelial cells became spherical and the nucleus large and pale. Proliferation occurred frequently, the cells sometimes increasing to a depth of several layers.

The slight evidence of the development of cell processes, the writer states, can be explained entirely by mechanical means. The epithelial cells always show the characteristics which distinguish them from the fibroblasts, and no metamorphosis of epithelial cells into fibroblasts, or *vice versa* could be made out.

The interweaving of the processes of the epithelial cell on two opposed surfaces, as described by Gaser, was not observed, but in cases of slight inflammation, a thin, almost imperceptible layer of fibrin could be seen.

The origin of the fibroblasts and of the various sub-epithelial cells containing karyokinetic figures could not be determined.

Fibroblasts were found in many cases arranged perpendicularly to the surface of the peritoneum, their processes frequently extending between the epithelial cells, even into the tissues of the opposed peritoneal wall.

All the appearances found could not be explained, but the writer hopes by continuing the work to clear up doubtful points. E. S.

J. Jolly. Recherches sur la values morphologique et la signification des differents types de globules blancs. Arch. Med. Exp. 1st. Ser., **10**: July–Sept., 1898.

The conclusions reached by this writer are as follows: In the normal blood of animals, and particularly of man, it is not possible by morphological characteristics and histochemical reaction to trace all the intermediate forms necessary to connect the lymphocyte with the coarse granular eosinophile. All necessary forms can be found to connect the mononuclear forms. In the blood of certain forms of leucæmia all stages between lymphocytes and the polynuclear cells can be found. These intermediate forms probably exist in normal blood, but are rare.

The leucocytes are elements of the same family, having a common amœboid activity. They probably all arise from a single form and the later changes in form are due to environment during development.

The intermediate forms not found in the peripheral circulation are to be sought in the hæmatopoietic organs. W. H. B.

Lack. The Experimental Production of Cancer. Jour. of Path. and Bact. **6**: 154, 1899.

Lack claims he has produced cancer experimentally. He holds that carcinoma is simply the result of the entrance of the normal epithelium of the body into the lymph-spaces, and its continued growth therein. To test this view he operated upon two rabbits. The ovaries were cut open and the raw surfaces scraped freely with the edge of the knife. The milky juice containing free epithelial cells was carefully allowed to diffuse through the peritoneal cavity. One of the animals died within forty-eight hours, the other remained well for nearly a year. Then it became gradually weaker and thinner, and was killed. Numerous hard white nodules were found in the mesentery. The liver was greatly enlarged, and contained many cysts; thickly scattered through it were numerous small white patches, densely hard on section. The diaphragm was infiltrated with dense whitish tissue, and the parietal pleura, the lungs and the uterus contained nodules similar in appearance to those in the mesentery. Microscopically they were shown to consist of alveolar spaces lined by one or more layers of columnar epithelial cells. The new growth had all the characteristics of ovarian cancer.

The writer does not believe that the production of general carcinomatosis of the peritoneum, occasionally seen after rupture of ovarian cysts, is always due to a malignant growth in the cyst, but believes it possible for the normal epithelial cells thus set free to produce carcinoma by growth along the peritoneal lymphatics. J. H. P.

Sternberg, Carl. Cell Inclusions in Carcinomata and their Relations to the Blastomycetes. Ziegler's Beiträge; Bd. **25**: Heft 3, 1899.

Sternberg finds that the best so-called "specific stains" are unimportant modifications of Gram's stain. Control specimens stained by Gram's method give practically the same results. He classes under intracellular structures vacuoles, leucocytes, areas of mucoid degeneration and calcification, red blood corpuscles, keratinised areas, kerato-hyaline granules, nuclei and nucleoli. Some muscle bundles, the root sheaths of hairs, hyaline and colloid retain the stain by Gram's method. All these are familiar structures in the ordinary hematoxylin and eosin specimens. Referring to the figures in the works of the supporters of the parasitic theory, he finds that the structures there represented may all be classed under these heads.

He finds nothing satisfactory in the recorded chemical and inoculation tests.

E. S.

CURRENT BACTERIOLOGICAL LITERATURE.

H. H. WAITE,
University of Michigan.

Separates of papers and books on bacteriology should be sent for review to H. H. Waite, 709 North University avenue, Ann Arbor, Michigan.

Hite, B. H. The Effect of Pressure on the Preservation of Milk. W. Va. Agr. Exp. Sta. Bull. No. 58, June, 1899.

Samples of milk were subjected to pressures varying from a few hundred pounds up to two hundred thousand pounds to the square inch.

Samples subjected to a pressure of ninety tons for one hour, remained sweet for more than a week. Pressure varying from thirty to one hundred tons, applied for one hour will delay souring for twenty-four hours; thirty tons applied for ten or twelve hours will prevent souring for from three to five days; samples that have been under a pressure of from five to thirty tons for two weeks, could not be distinguished from morning's milk. The experiments were all carried on at room temperature. The effects of pressure on the milk differ from the effects of pasteurization; pressure hinders souring, but does not reduce the disease germs to any great extent.

The effects of heat and pressure combined were tried with results more favorable than for pressure alone. Tubes filled with milk that had stood in the laboratory all day, and was then subjected to pressures of from seven to twelve tons and temperature of 152° to 160° F. for one to three hours, remained sweet for three weeks. Control samples soured in thirty-six hours. E. M. B.

Klein, E. Zur Kenntniss des Schicksals pathogener Bakterien in der beerdigten Leiche. Centralbl. f. Bakt., **25**: 737–744, 1899.

Experimental studies were made to determine how long after burial, infection was possible from diseased animals. Animals were injected with different pathogenic bacteria, and immediately after death were buried in tin or wooden boxes, or directly in sand or damp earth without any box. They were then exhumed after varying lengths of time and other animals injected with preparations made from the diseased parts. *Bacillus prodigiosus* produced no effects whatever after the animal injected with it had been buried six weeks. Staphylococcus produced no effects after being buried two months, the cholera bacillus after twenty-eight days, the typhus bacillus after twenty days, diphtheria after twenty-one days. Tuberculosis was tested only after burial for seven weeks and produced no effects. Specimens injected with a preparation from an animal that had died of bubonic plague and had been buried twenty-one days were not affected. Among most of these forms there were some cases in which the power of infection was lost in less time than that cited, the time quoted here being that at which there was no further reaction from the disease. The results give evidence that bacteria do not live long in dead bodies, and that the power of infection is soon lost.

E. M. B.

Biel, Dr., A. F. Movement of Bacilli, etc., in Liquid Suspension on Passage of a Constant Current. Centralbl. f. Bakt., **26**: 257–259, 1899.

Passage of a constant current through hanging drop cultures of motile bacteria produce uniform motion toward the positive pole independent of the customary darting about of the bacteria. This motion was succeeded by a reverse stream in the lower part of the drop, toward the negative pole.

Bacteria *pyocyaneus*, *proteus*, and *coli* were used in the experiments, and they were suspended in various fluids, among which were distilled water, a one per cent. solution of peptone, one per cent. asparagine, five per cent. carbolic acid, and various strengths of sulphate and of hydrochlorate of quinine. The results were the same in all the experiments, except that in the one per cent. peptone solution there was movement only after several minutes, or not at all, and that in bouillon the currents were in the opposite directions. The same results were obtained with dead bacteria. To exclude the element of chemotaxis from the experiment, dead bacteria were mixed with powdered inorganic substances such as carmine, lampblack, etc., with the same results as before. The writer considers the experiments to give evidence that the reaction is due to physical rather than physiological causes. E. M. B.

Sicherer, Dr., Otto v. Zur Chemotaxis der Leukocyten in vitro. Centralbl. f. Bakt., **26**: 360–361, 1899.

A sterile exudate, rich in leuocytes, was placed in a wide glass tube, and capillary tubes containing different substances were suspended in it. The capillary tubes were sealed at the top, while the lower, open end extended about one cm. below the surface of the fluid, and they were fastened so that they could not be moved.

Yeast cells and dead staphylococcus cultures attracted the most leucocytes, while tubes with one per cent. corrosive sublimate, one per cent. cinnimate of sodium, three per cent. salt solution or normal salt solution were almost or entirely free from leucocytes. E. M. B.

Conn, H. W. Variability in the Power of Liquifying Gelatin Possessed by Milk Bacteria. Centralbl. f. Bakt., **5**: 665–669, 1899.

Dr. Conn's observations on the variation of bacteria growing under natural conditions are added to those already made upon variations produced by differences in conditions of cultivation.

Studies were made upon the bacteria of milk from different dairies. One micrococcus was found in cultures made from milk and also in cultures from plates exposed to the air in the same dairies. Associated with this form was found another, differing from the first only in not liquifying gelatin. Intermediate forms with varying power of liquifaction also developed from the same series of cultures. After continuing the experiments for several months, a second series developed that formed snow-white colonies in gelatin, agar, and potato cultures instead of orange-yellow as before, and later all intermediate shades of color developed in these cultures. The case is peculiarly significant from the fact that all these varieties have been found in nature under apparently identical conditions, and not produced by artificial cultivation. The question arises as to whether these different cultures may be considered as belonging to

the same species. Dr. Conn believes, on account of their great similarity in other respects, that they belong to the same general type. Further studies described in the paper give evidence that natural races of the same organism may differ in their power of liquifying gelatin. The points noted are of interest from the fact that the power of liquifying gelatin is one of the first characteristics considered in separating different groups of bacteria. E. M. B.

Russell, H. L., and Bassett, V. H. Effect of Digesting Bacteria on Cheese Solids of Milk. Sixteenth Annual Rep. Wis. Agri. Exp. Sta., 1899.

This report outlines the results obtained from inoculating both sterile milk and milk not sterilized but received under conditions which would reduce contamination to a minimum, with cultures which were known to have an extensive digesting action on proteins.

Although the number of experiments made and the number of germs used are not large enough to draw any general conclusions from, nevertheless it was shown that there was no appreciable change in the amount of insoluble casein in the milk after exposure of eight to twenty hours, under conditions most favorable for the growth of bacteria. This fact shows that losses in milk for cheese making are not caused by the digestion of casein by bacteria. H. H. W.

Russell, H. L., and Bassett, V. H. Effect of Different Influences on Normal Temperatures of Cattle, and Relation of same to Tuberculin Test. Sixteenth Annual Rep't Wis. Agri. Exp. Sta., 1899.

These experiments were made to determine the effect of water, "rut," parturition, advanced gestation, and dehorning on the temperature of cows. It was shown that the ingestion of large quantities of water (cold) as a rule produced a marked fall in temperature. If large quantities of cold water were given while the tuberculin test was in progress, this might be invalidated by the change due to the water. If the water is given frequently and in small quantities, the accuracy of the test will not probably be affected. As might be expected, dehorning caused a considerable rise in temperature, but it would rarely if ever occur that dehorning and testing with tuberculin were performed at the same time. The temperature in parturition, gestation, and in "rut" did not show any deviation which would lead to error in testing with tuberculin.

H H. W.

Bassett, V. H. Examination of Milk for Tubercle Bacilli. Sixteenth Annnal Rep. Wis. Exp. Sta., 1899.

Thirty samples of milk and four samples of separator slime were examined. All of the animals from which the milk was obtained reacted to tuberculin, but there were no observable udder lesions. Control experiments were carried out by introducing tuberculous sputum into a portion of each sample, and from those containing sputum the organism was always demonstrated. In the portion which did not contain sputum the germ would not be found. H. H. W.

Sturgis, W. C. A Soil Bacillus of the Type of DeBary's B. Megatherium. Phil. Trans. Royal Society of London, Ser. B, **191**: 147–169, 1899.

An organism to which the author has given the name *B. hortulensis* was isolated from the soil, and is uniformly found in clayey soil at a depth of one-half to one inch below the surface. The organism was isolated from a sample

of clayey soil which had been heated for five minutes at a temperature of 99° C. The soil was then transferred to an acid saccharine culture medium. No colonies of bacteria or moulds developed except of the *B. hortulensis*. It does not grow as well on media which do not contain sugar, and in distinction from most bacteria grows well on a medium containing acid. On potato, and in media containing sugar it forms capsules, but often loses this characteristic when transferred to media devoid of sugar. This organism resembles more closely the *B. megatherium* than *B. sultilis*, or *B. mesenterius*, but is probably not of the same family.

H. H. W.

Richardson, M. W. On the Presence of the Typhoid Bacillus in the Urine. Jour. Exp. Med., **III**: 349-361, 1898.

In thirty-eight patients the typhoid bacillus was found nine times or in nearly 25 per cent. of the cases. In 172 tests of the urine, the Eberth bacillus was found 44 times. In the 44 tests in which they were found, they were present in great numbers and in nearly pure cultures. The bacilli appear first in the later stages of the disease and persist for a long time during convalescence. These investigations show the necessity of disinfecting the urine of convalescents as a prophylactic measure.

H. H. W.

Park, Dr. W. H. Changed Appearance of Diphtheria Bacillus. Med. Rec. **56**: 755, 1899.

A note read by Dr. Park before the New York Pathological Society states that he made a photograph of a diphtheria bacillus that had been under constant cultivation for four years. There was a striking change in the appearance of the bacillus, it having become twice as long as before, and more slender, and it lacked the characteristic club-shaped form.

E. M. B.

NEUROLOGICAL LITERATURE.

EDITH M. BRACE.

Literature for Review should be sent to Edith M. Brace, 131 Park Avenue, Rochester, N. Y.

Hesse, Richard. Untersuchungen über die Organe der Lichtempfindung bei niederen Thieren. V. Die Augen der polychæten Anneliden. Zeits. f. Wiss. Zool., **65**: 446-516, Tf. 22-26, 1889.

This report of studies on the eyes of the *Polychæta* describes so many forms that an adequate idea of the work can hardly be given in the space of a review. The type of eye found in *Nereis cultrifera* may be considered as an invagination of the epidermis in which the cells are elongated and arranged around a common center, and the whole covered with cuticle. The wall of the vesicle contains two kinds of cells, visual and secreting. The visual cells have a nerve fiber, extending proximad and distad. They carry rod-like bodies that are tubular in structure, have a thick, deeply staining wall, are not closed toward the cavity of the eye vesicle, and are filled with plasmatic, bright staining and slightly granular contents. A fine fibril running through the plasma stains dark blue with hæmalum, and corresponds to a primitive nerve fibril of Apáthy. This is taken to be the essential light-perceiving element. It has no specially developed termination.

Cells forming the inner wall of the vesicle (inner cornea) are pigmented. The secreting cells have not much more power of secretion than the same cells in the epidermis, with which they are homologous, and are connected with the refractive body which they secrete. The refractive body is similar to the cuticle in structure and is continuous with it. It may be granular or striated according as it is secreted by one cell or by several.

The two other chief types of eyes described are beaker-eyes, and epithelial eyes. The beaker-eyes have one or more visual cells with one end resting in a cellular pigment cup. They may lie in the epithelium, or under it in connective tissue, or they may have sunken in until they rest upon the brain, but they do not reach the upper surface of the epithelium like the epithelial eyes. Their position may be anterior or posterior, or they may be disposed segmentally over the whole worm.

The epithelial eyes are divided into two classes, one class having visual cells similar to those of the beaker-eyes. These cells have a part, usually a rod-like structure, specially sensitive to light, turned toward the surface. Cells of this class were never found alone, but always in masses, separated by only a few supporting cells; they form visual epithelia, retinæ which are always more or less sunken in the surface of the epithelium. The gradual sinking away from the surface may be traced in different forms of the Chætopoda. The pigment of these eyes may be in the visual cells, or in a cell beneath it. The second kind of epithelial eye is characterized by cells which secrete a lens-like body on the side toward the surface which is more or less closely connected with the cuticle. Such eyes are found only in the Serpulaceæ. Here the light-perceiving part lies proximad to the lens. The pigment surrounds such cells in the form of a tube, open distad to admit the light and proximad for the nerve fiber. Such cells may be single or in crowded groups, with the visual cells converging like the simple components of facetted eyes in the Anthropoda. This constitutes a compound eye.

Branchioma, like the insects, has two types of eyes, one on the brain, the other on the gills. The type of eye located on the brain is a tube with cellular wall, pigmented toward the brain, and, on the side toward the light, having sensory cells which send a blunt process containing a bundle of fibrillæ into the lumen of the tube.

Hesse believes that this organ is similar to the eye-vescicle of the vertebrate ancestors, i. e., a cellular vesicle pigmented on the side toward the brain, and having sensory cells with rod-like bodies turned toward the lumen of the vescicle.

In all types of eyes the primitive fibril is the essential light-perceiving element. Accessory structures vary. In the eye of *Nereis*, the fibril runs through a rod-like body which is tubular and serves to support it.

The so-called lateral eyes of *Polyophthalmus pictus* present the essential characteristics of beaker eyes. Here, the cells on the side toward the pigment cup are slitted into a number of finger-like processes, which have a fringe of light-perceiving elements over their whole surface. All transitional stages are found between these and the brain eyes, which have no finger-like processes.

This slitting of the cell appears to be a device for increasing the area for light perception. The eyes of Annelid larvæ are also beaker eyes; their presence here as well as in the Platyhelminthes is taken as evidence that they represent a very primitive form of eye. E. M. B.

Atherton, Lewis. The Epidermis of Tubifex rivulorum Lamarck, with especial Reference to its Nervous Structure. Anat. Anz., **16:** 497–509, 5 text. figs., 1899.

This Oligochæte worm forms a flexible tube from particles of mud cemented together with mucus, and is found along shallow ponds and rivers.

It may contract and withdraw entirely into the tube, but usually the anterior or head end is pushed down into the mud, where it obtains its food, the median portion lies in and is protected by the tube, while the tail moves above free in the water, so that there are three regions distinct from each other with regard to the sensations likely to be received.

There are three conditions found among the sensory cells of the epidermis; isolated flask-shaped cells, cells aggregated into loose groups, or more closely united into definite sense organs. These may be considered as genetic stages, or as modifications of a degenerative nature, due to the tubiculous habit of the worm. The necks of the isolated, flask-shaped cells reach the cuticle and sometimes extend a third of the way through it. Proximad they send a fiber to the central nervous system and distad they carry from one to five sensory hairs, but the ones with more than one hair are found only in the prostomium and the first ten body segments; as this area is concerned in working through the mud in search of food, its sensory apparatus plays an important part and it is possible that the excess in the number of hairs serves the purpose of increasing the sensory surface. The isolated cells are most numerous over the prostomium and anterior portion of the body, somewhat less numerous over the posterior portion, and least in evidence in the median portion that always lies in the tube. The loose groups are everywhere except in the anterior extremity and are numerous in the tube-protected region. They consist of from two to four sense cells which do not differ in any way from the isolated cells. The sense organs consist of from four to seven sense cells, forming a conical structure, in which the form of the cells varies somewhat according to position. A characteristic of these organs is an elevation of the cuticle into which the necks of the cells project. E. M. B.

Elliott, Dr. George R. Notes on Laboratory Methods. Post-Graduate **11:** 336–348, 2 figs., 1896.

Among the methods discussed in this paper is Giacomini's method for making dry brain preparations. The brain is left in a saturated solution of chloride of zinc for two or three days, then in 95 per cent. alcohol for ten or twelve days, followed by glycerine for twenty to thirty days. It is then removed from the glycerine and dried in the air, and it may be varnished or given a coating of marine blue diluted with water. E. M. B.

Laudenbach, Dr. J. Zur Otolithen-Frage. Archiv f. Physiol. **77:** 311–320, 1899.

These experiments were made to determine the part played in the control of motion by the sacculus and the otoliths of the vertebrate.

Siredon pisciformis and the frog were used for the experiments. If the

labyrinth on one side of Siredon is extirpated, the animal will turn around the longitudinal axis of the side operated upon; if both labyrinths are extirpated, it becomes completely disoriented, and swims in a circle, often with its body partly out of the water. Although unable to maintain its equilibrium in the water, the animal is able to orient itself through the sense of feeling of its extremities when it comes in contact with the bottom of the aquarium, and it is helpless if the extremities are amputated. The gills become greatly developed when both labyrinths are extirpated, probably because the animal finds difficulty in coming to the surface to breathe. In a series of experiments in which the otoliths were removed from one side or from both sides, no disturbance of equilibrium or of motion was observed, but such disturbances always occurred after the removal of the labyrinth.

Frogs from which the otoliths had been removed from one side or from both sides moved normally in a short time after the operation, but showed characteristic changes in motion and in position after removal of the labyrinth.

E. M. B.

A Case of Glioma of the Lower Cervical Region of the Spinal Cord. Rev. in Am. Jour. Med. Sc., June, 1899.

A monograph by Drs. W. H. Hudson, L. F. Barker and Simeon Flexner reports a case of tumor in the spinal cord between the level of the third and fourth dorsal vertebræ. The upper five centimeters of the tumor extended nearly across the cord, and there were cone-like projections above and below. It was surrounded with softened cord. In this way the connection between the upper and lower parts of the cord was completely lost, but during the life of the patient the skin reflex of the legs and feet was present, there was violent ankle clonus and an exaggerated knee-jerk, but no sensation below the third rib in front and the spine of the scapula behind. The lumbar enlargement was healthy, and this was thought to be the reason that interruption of the connection with the cerebellum did not result in the loss of reflexes.

E. M. B.

Bethe, A. Demonstration of Primitive Fibrillæ. Archiv. f. Anat., **54**: 141, 1899. Abs. Jour. Ment. and Nerv. Dis., **26**: 676, 1899.

Leave small strands of nerve tissue in osmic acid for about twenty-four hours, wash four to six hours, and place in 90 per cent. alcohol for ten hours. This is followed by water for four hours, after which material is transferred to a mixture of a 2 per cent. solution of sodium bisulphate and concentrated hydrochloric acid in the proportion of ten drops of the former to three or four drops of the latter. Specimens are left in this from six to twelve hours, washed, dehydrated, cleared and embedded in paraffine. Sections are cut very thin and fastened to the slide with albumen fixative. Stain for ten minutes in a one-tenth of 1 per cent. solution of ammonium molybdate and mount in Canada balsam.

E. M. B.

Schefer, E. A., and Swale, Vincent. The Physiological Effects of Extracts of the Pituitary Body. Jour. Physiol., **25**: 87, 1899. Abs. Jour. Nerv. a. Ment. Dis., **26**: 719, 1899.

Extracts of the infundibular portion of the pituitary body when intravenously injected produce a marked rise or fall of the blood pressure, according

to the nature of the extract used. These active pressor and depressor substances are not destroyed by boiling and may be dialysed.

The pressor substance acts both upon the heart and upon the peripheral arteries, and its action is prolonged, while the action of the depressor substance is evanescent. The characteristic effects of the extracts are thought not to be due to the gray nervous matter of which the infundibulum is largely composed.

E. M. B.

RECENT LITERATURE.

Braus, H. Beiträge zur Entwicklung der Muskulatur und des peripheren Nervensystems der Selachier. II. Morph. Jahrb., **27**: H. 4, 1899.

Sjövall, E. Die Zellstructur einiger Nervenzellen und Methylenblau als Mittel sie frisch zu untersuchen. Anat. Hefte, Wiesbaden, **12**: Heft. 3, 1899.

Denker, A. Vergleichend-anatomische Untersuchungen über das Gehörorgan der Saügethiere nach corrosions Präparaten und Knochenschnitten. 4to, pp. 7 + 114, 17 plates, Leipsig, 1899.

Cajal, S. R. Die Structur des Chiasma opticum nebst einer allgemeinen Theorie der Kreuzung der Nervenbahnen. Trans. by J. Bresler. 8vo, pp. 7 + 66, 12 illus., Leipsig, 1899.

Edgeworth, F. H. On the Medullated Fibers of some of the Cranial Nerves and the Development of Certain Muscles of the Head. 8vo, pp. 38, 13 plates, 1899.

Valenza, G. B. Nuove ricerche sulla genesi degli Elementi nervosi e neuroglici e sul loro reciproco rapporto. Posthumus work published by A. Anile, Naples. 8vo, pp. 7 + 99, 1 plate, 1899.

Paravicini, G. Ricerche anatomico-istologische sue gangli stomato-gastrici dei Gasteropodi terrestri. Milan, 8vo, pp. 16, 1 pl., 1899.

NOTES ON RECENT MINERALOGICAL LITERATURE.

ALFRED J. MOSES AND LEA MCI. LUQUER.

Books and reprints for review should be sent to Alfred J. Moses, Columbia University, New York, N. Y.

Friedel, G. Analyse d'un silicate d'aluminium et de sodium artificial. Bull. Soc. Minn., **22**: 17, 1899.

The substance obtained by the action of a soda solution on mica at high temperature, and proved to have a very similar composition to thomsonite.

L. MC I. L.

Friedel, G. Sur un nouveau silico-aluminate artificial. Bull Soc. Minn., **22**: 20, 1899.

Formed under special conditions by the action of caustic soda upon muscovite in the presence of water. Crystals colorless, transparent and monoclinic, with pseudo-isometric form (octahedral-like planes best developed) and complicated internal structure.

The crystals have not the same symmetry when cold as at the temperature of formation, therefore the binary symmetry when cold has not determined the faces of the crystals.

Composition = $8SiO_2$, $3Al_2O_3$, 6 Na_2O. G.=2.66 at 12.5° C. Easily attacked by hydrochloric acid.

L. MC I. L.

Pirsson, L. V. On the Phenocrysts of Intrusivê Igneous Rocks. Am. Jour. Sci. 4, **VII**: 271, 1899.

The idea is very prevalent that the "phenocrysts" of porphyritic rocks are older than the groundmass and "intratelluric" in origin. The author concludes from evidence of contact zones, dikes

and sheets, fluidal phenomena and microscopical study, "that not all phenocrysts in *intrusive* rocks are intratelluric in the sense that they have been formed at much greater depths than they now occur in, but that on the contrary in many cases they have been formed in place and are of contemporaneous origin with the other constituents of the rocks." L. MC I. L.

Rinne, F. Beitrag zur Kenntniss der Natur des Krystallwassers. Neues Jahrb. f. Mineralogie, 1: 1–31, 1899.

The writer considers at length, with many experiments, the very different behavior of water of crystallization in such salts as copper sulphate $CuSO_4+5\ H_2O$, or Barium chloride $BaCl_2+2H_2O$ on the one hand, and heulandite or stilbite on the other.

The substances to be tested were placed in glass vessels open at the top and containing a thermometer, around which the salt was packed. The glass vessels were then thrust through a hole in the cover into a vessel of known higher temperature, and the temperature recorded every half minute. If the substance tested contained no crystal water its temperature increased with fair regularity.

With the copper sulphate or barium chloride the increase in temperature was not steady, but presented a great analogy to the conversion of water into steam, there being, however, more than one 'boiling point' for the water of crystallization.

For instance, a barium chloride surrounded by a temperature of 175° increased gradually in temperature to 104°–105°, remained at this temperature several minutes, and then rose rapidly to 117°; with higher outer temperature the rise continued rapidly to 161°–165°, when there was another halt of several minutes.

These two boiling points, 104°–105° and 161°–163°, each corresponded closely to a loss of one molecule of water.

Similarly the copper sulphate gave distinct periods of rest at 99°, 105°, 117° and 258°, these corresponding respectively closely to losses of $\frac{1}{2}\ H_2O$, $2\ H_2O$, $4\ H_2O$ and $5\ H_2O$.

Just as with water turning to steam, it was shown that the boiling point of crystal water was lowered by lowering the pressure.

Salts, such as barium chloride or copper sulphate are changed by loss of water into other salts with lower, but still simple, molecular relation between the salt and the water of crystallization.

When heulandite or stilbite, however, is similarly treated, there is a gradual loss of water conditioned apparently by the temperature and the dryness of the surrounding space, but there are at no stage periods of rest or boiling points corresponding to loss of entire molecules of water.

Thus, heulandite in dry air over sulphuric acid lost in 791 hours 4.17 per cent., in a vacuum it lost in 400 hours 4.81 per cent., in damp air it absorbed in 90 hours 1.08 per cent.

At a gradual temperature increase from 80° to 400° the loss gradually reached 14.20 per cent.; raised still higher to 555°, the loss reached 15.44 per cent.

These losses do not correspond to any simple number of molecules of water.

The gradual alterations in contents of crystal water is in heulandite accompanied by a gradual change in optical characters.

The conclusion is that the water of crystallization in salts such as barium chloride is in molecular combination, but that in heulandite there is a (*feste Lösung*) solid solution, the variable "boiling point" of which has not been observed.

A. J. M.

Holland, T. H. Barytes, Quartz Rock from Salem, Madras. Recds. Geol. Sur. India, **25**: 236, 1897.

Rock has appearance of pegmatite, is probably of igneous origin and, from the average specific gravity, consists of 69.2 per cent. quartz and 30.8 per cent. barite. This mode of occurrence of barite is unique.

Scottish Minerals. Trans. Edin. Geol. Soc., 3 Part, **7**: 1897.

Many interesting local occurrences and descriptions given.

Wallerant, F. Théorie des anomalies optiques, de l' isomorphisme, et du polymorphisme, déduit des Théories de MM. Mallard et Sohncke. Bull. Soc. Min., **21**: 188–256, 1898.

An exhaustive treatise on these subjects.

Becker, Geo. F. Determination of Plagioclase Feldspars in Rock Sections. Am. Jour. Sci., iv. **5**: 349, 1898.

A brief resumé of Michel-Levy's methods of determining plagioclase crystals (showing either albite or albite-carlsbad twinning) and microlites (showing marked extension or approximately square cross-section). A carefully revised and prepared plate gives characteristic extinction angles, with most common angles specially mentioned, for zone at right angles to (010) and also for zones inclined 10° to this zone in both directions.

Author also mentions fact that all the microlitic feldspars in a groundmass may not belong to the same species, although they usually do so; and supports theories of Bauer, Mügger, Werwcke, Judd, etc., that polysynthetic twinning may be largely due to stresses during cooling and not the result of simple crystallization.

L. McI. L.

INDIVIDUAL SPECIES.

Arsenopyrite, Constitution of. F. W. Starke and others. Jour. Am. Chem. Soc., **19**: 948, 1897.

As result of investigations the provisional formula is given as 14 Fe″As‴S. 2 Fe‴As‴S.

Chromite, On the Occurrence, Origin and Chemical Composition of. J. H. Pratt. Am. Jour. Sci. IV, **VII**: 281, 1899.

Author concludes that the chromite (in N. C.) has been formed at the same time with the peridotite, i. e., "as having been held in solution by the molten mass of the peridotite and crystallized out among the first minerals as the mass began to cool."

The mineral occurs as grains in the peridotite and in larger rounded masses near the contact of the peridotite with the gneiss or other country rock.

L. McI. L.

Roscoelite. W. F. Hillebrand and H. W. Turner, with Note on its Chemical Constitution by F. W. Clarke. Am. Jour. Sci. IV, **VII**: 451, 1899.

Formula of this rare mica hitherto doubtful and still undetermined by analyses of Hillebrand on specimens from Stockslager mine.

Clarke (using Hillebrand's analyses) regards mineral as a molecular mixture of the three compounds:

$$\begin{array}{ccc} (1) & (2) & (3) \\ Al\left(\begin{array}{l} SiO_4{\equiv}FeK \\ SiO_4{\equiv}MgH \\ SiO_4{\equiv}MgH \end{array}\right. & Al\left(\begin{array}{l} Si_3O_8{\equiv}KH_2 \\ Si_3O_8{\equiv}KH_2 \\ Si_2O_8{\equiv}Al \end{array}\right. & Al\left(\begin{array}{l} SiO_4{\equiv}KH_2 \\ SiO_4{\equiv}V \\ SiO_4{\equiv}V \end{array}\right. \end{array}$$

in the ratio 21:22:159, or nearly 1:1:8.

Of these component molecules, (1) represents the normal phlogopite type, (2) is a trisilicate alkaline biotite and (3) is a vanadium muscovite. Hence the mineral is essentially a vanadium muscovite.

California occurrences of roscoelite given by Turner, all the localities being near the contact of an intrusive granodiorite mass with surrounding rocks, chiefly sediments and older lavas.

The mineral (from Calif.) tends to crystallize in little rosettes, has small axial angle, is pleochroic and optically negative. L. McI. L.

Zéolithes, Nouveaux essais sur les. G. Friedel. Bull. Soc. Minn., **22**: 5, 1899.

On the water of chabazite. Author thinks probable that both silica and water may exist simply included and not entering into the constituent molecules. L. McI. L.

NEWS AND NOTES.

Amann, Jules. Neue Beobachtungsmedien. Zeits. f. wiss. Mikr., **16**: 38–44, 1899.

This paper gives the results of experiments upon mounting media especially adapted to plant tissues. Nine media are reported upon.

1. Chloral phenol, $N_D = 1.5241$.

Formula: Melt together
Crystallized Chloral Hydrate, 2 pts.
" Phenol, c. p., 1 pt.

2. Chloral-lacto-phenol, $N_D = 1.4932$.

a. Formula: Melt together at low temperature,
Crystallized chloral hydrate, 2 pts.
" Phenol c. p., 1 pt.
Conc. lactic acid (Sp. g. 1.21) 1 pt.

b. Chloral hydrate, 4 pts.
Phenol, absolute, 4 pts.
Lactic acid (Sp. g. 1.21), 2 pts.
Sodium salicylate, 1 pt.

These are melted together at high temperature and produce a medium in which $N_D = 1.5155$.

3. Lacto-chloral, $N_D = 1.4796$.

Formula: Equal parts of chloral hydrate and lactic acid.

This is very penetrating and has considerable dehydrating power.

4. Mono-chlor-phenol (C_6H_4ClOH), $N_D = 1.5671$.

5. Chloral-chlor-phenol $N_D = 1.5491$.
   Formula: Heat together equal parts of chloral hydrate and mono-chlor-phenol ($C_6 H_4 Cl OH$).
6. Lacto-chlor-phenol, $N_D = 1.5265$.
   Formula: Mix together
   Mono-chlor-phenol (C_6H_4ClOH), 2 pts.
   Lactic acid, 1 pt.
7. Chloral-lacto-phenol, $N_D = 1.4995$.
   Formula: Melt together equal parts of Mono-chlor-phenol ($C_6 H_4 Cl OH$), chloral hydrate and lactic acid.
8. A modification of (7) consisting in the addition of two parts per thousand of a concentrated aqueous solution of copper chloride.
   This tends to preserve the green odor of tissues.
9. Quinolin, $N_D = 1.6248$.

To Make Whole Mounts of Hydroids.—Fix in picro-acetic acid and stain for some time—two days—in borax carmine, decolorize in acid-alcohol and clear in clove or cedar oil for several hours. Hydroids prepared in this way show the cells in any part where the perisarc is not too thick.—*Martin Smallwood in the Am. Nat.*

Staining Sections.—The very finest cellular structures may be rendered plainly visible by coloring with an ammoniacal solution of carmine, to which a surplus of acetic acid has been added, then put them for from two to ten hours in a weak solution of ferric sulphate. Very useful in nuclear work in zoölogy and botany, and the black color seems durable.

Cement for Liquid Mounts.—Gutta percha dissolved in turpentine, and a little gold size added to give it tenacity, is very reliable. It does not run in, but should, after two or three coats have been applied, be covered with some other varnish, as it is apt to peel off. V. A. L.

Photomicrographs of Diatoms, Etc.—First photograph the diatoms with a magnification of not more than 100 diameters, then enlarge so as to obtain a photograph of 500 diameters, proper for photo-printing. Finest details are thus brought out, which otherwise are invisible to the eye in the smaller photograph. Even forgeries in legal documents can be discerned by using enlargement pictures, which *microscopically* are not visible, if printed on bromide or velox paper.

The California Academy of Sciences has received $10,000 from Mr. J. W. Hendric for a publication fund.

Dr. Phoustanos, of Greece, is editing a series of the most famous medical writings. Physicians in various parts of Europe are assisting, and American coöperation is also expected. The edition will be published in sixty volumes.

Journal of Applied Microscopy.

VOLUME III. FEBRUARY, 1900. NUMBER 2

The Microscope in the Primary School.

The microscope, as an adjunct to the class-work of the elementary schools, is so nearly unknown that any words in favor of its introduction must, for some time to come, be words in its defense.

The purpose of Nature Study in the public school is two-fold:

The creation and cultivation—

1. Of love for the truth (for nature is truth).
2. Of the power to gratify this love.

In order to love, we must know; and what we love we will pursue if we have the power. The text-book on nature, whether it be the printed one that lies between two covers, or the oral one that walks on two legs, can never communicate to the child either this love or this power. These must both be won by personal acquaintance.

One perfect means of gaining this acquaintance is to seek out animal or plant in its own home, and there hold personal intercourse. This way, however, is not usually considered available for the scholars in the city public schools, as it would entail expense and some loss of time; but one day well planned and thus spent is worth weeks of indoor work.

The only other successful means for nature study is the active employment of eye and hand in the school-room; but both eye and hand, for delicate observation and manipulation, must receive cultivation, and the lens offers itself as a practical and friendly trainer.

The love of a secret is inborn in the soul of man. Take a walk with a boy in the woods. The stone, however beautiful, which lies in his path, is shied into the brook; but the crooked little pebble which he has pried out of a hollow in the rock is tenderly put among his pocket treasures.

The lens is Blue-beard's key of mystery, but instead of unlocking a closet of horrors, it opens the door to a world of wonders. The lens is Aladdin's lamp of riches, for by one glance of its brightness we discover, hidden on the hind leg of the robber-bee, the tiny bag filled with gold which he has stolen from the flowers. The lens is the magic spade with which we will dig for Captain Kidd's treasures, and by its aid the very dust from the rocks of the seashore reveals itself as a casket of precious jewels. By its power even the unattractive is made attractive. The speck of mold on a crust of bread is a goblin's orchard; the homeliest little daisy is a whole garden of flowers; and the fairy wand which

causes this transformation is not an expensive compound microscope used by the teacher, but a common little lens in the hand of a child. If this work is supplemented occasionally by a view into the compound microscope, there is no limit to its usefulness.

The power of observation does not come for the asking. He who would run fast must learn to take the first step, and sometimes a "walking-machine" is found to be the best teacher for the awkward little feet. So also the use of an artificial third eye may be the best trainer for the two blind natural eyes that look but cannot see.

The foot has always, even in savage tribes, received its share of attention; the hand will be the pet of the twentieth century; the tongue in the schools yet kindleth a great matter; the ear is taught to detect niceties of sound; but the poor nose has been totally neglected, and the eye, the king of the senses, has been even abused. Talents differ, the commonest vessel has its office. Every city school contains a certain class of children to whom the training of the sense of smell would be a priceless boon. It would open to these children the secrets of health and happiness, the beauty of purity, and the dangers that accompany uncleanliness and vice.

As for the eye, what training in its use and care has any little child received in the family or in the school? "Look!" he is told, "look and read!" And the child looks and sees nothing, and he reads in the fading light till the words blur before the tired eyes. If for no other reason than this, the introduction of the lens into the school, with proper guidance, would be of the greatest benefit, for the first point that is taken up with students by the good teacher of microscopy is the care of the eye and of the instrument.

Let us listen to some of the cautions:

For the *Eye:*

Use a good light, not too strong, not too feeble; alter the light and your position according to the object to be examined and the length of the period of study. On a dark day, do not use the lens at all; protect and shield the eye from the light that shines upon the object; do not use the eyes too long at a time, not at all if you are sick or tired. Let your eyes take turns, that one may rest the other; close them once in a while; do not strain them trying to see, look naturally, as if at a picture; do not examine the object till it is clear and sharp.

For the *Instrument:*

The lens should be kept clean, but it should not be rubbed with anything that is carelessly picked up; never with a handkerchief. A little scratch on the lens may injure the eye as well as the lens; remember that fact, children, when the day comes that you have to wear spectacles! A delicate rice paper is used by careful microscopists for rubbing the lenses. When you are through working, put this soft silky little piece of paper tidily away in a clean little box. Keep the slide bright. Do not be rough with the instrument. Do not break the tender little cover-glass.

What delicacy of touch the microscopist must have just to handle and clean these cover-glasses, which are sometimes of extreme thinness, and yet may be rubbed with considerable force without breaking. All schoolwork has a bearing

upon life-work. The handling of the thicker covers by the older children must result in the exercise of care and skill, and I am sure that the most skeptical mother can see the close correlation with a certain very necessary part of the daily housekeeping, and will appreciate the prospective saving in glassware and china.

Care for *Others:*

Do not shake the desk at which your neighbor is working. Tread on tip-toe across the floor. The slightest jar may hurt his eye and prevent him from having the pleasure which you have had. Respect the rights of your neighbor and enjoy with him his success.

The lens is not a toy for free play, but an educational one to be used under the intelligent supervision of the teacher, and the interest that it excites will well repay the necessary watchfulness. It is generally conceded that character-building should be the supreme aim of the teacher. Just glance over the common directions before given and see what they include.

1. Care for the sight and that knowledge of light and its varying qualities which is indispensable to such care. The health of the eye as related to the health of the body; the interdependence of the members of the body; their need of rest.

2. In regard to work:

The necessity for cleanliness, for system, for patience, for perseverance, for gentleness, for the exercise of skill rather than force. Helen Keller, the deaf, dumb and blind girl, can, by the touch of the finger, distinguish a pansy's dark petal from a bright one. How? By what to us would be an inappreciable difference in thickness. Not by one day's practice in touching did she gain this delicacy, but by that of many long years.

3. In regard to the members of the human family, the knowledge that there exist the same interrelation and interdependence as exist between the members of the human body. Each individual is but one cell of the universe.

The child who cannot learn these principles cannot learn to use rightly the simplest lens in a school; and he who has acquired this knowledge has gained it, not from Precept, but from Doing; and this is the primary principle of primary work.

FANNY JULIEN.

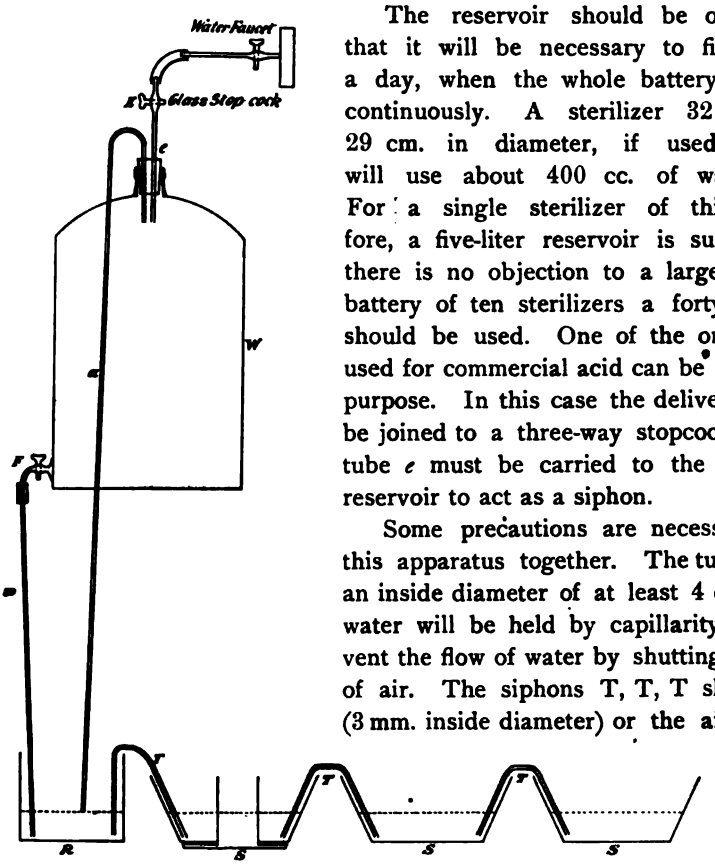
New York.

Regulation of the Water Supply in Arnold Steam Sterilizers.

The device for regulating the heat in the Arnold Steam Sterilizer is as perfectly automatic as possible. The regulation of the water, however, requires careful attention, or, as happens very often in students' laboratories, the water pan becomes empty and the sterilizer is ruined.

To supplement the lax attention of the average student, the following-described device has been used with perfect satisfaction in this laboratory for some time. It consists of a water reservoir, W, which is filled when necessary by opening the stopcock E and closing F. When full, E is closed and F opened. The water flows from the reservoir at F into a glass or earthenware jar, R. It

flows freely into this jar until it closes the mouth of the tube *a*. As soon as the water rises in *a* to the level of the water in the reservoir, the supply of air is shut off and the flow of water stops. The sterilizers S, S, S are connected with each other and with R by glass siphons T, T, T, so that the water stands at the same level in the whole battery. As the water diminishes in volume by evaporation the mouth of tube *a* is uncovered, allowing air to enter the reservoir and the water to flow from F until equilibrium is re-established.



a. Glass tube for entrance of air. Inside diameter 5 mm. T. Glass tube. Inside diameter, 3 to 4 mm.

The reservoir should be of such a size that it will be necessary to fill it but once a day, when the whole battery is being used continuously. A sterilizer 32 cm. high and 29 cm. in diameter, if used continuously, will use about 400 cc. of water per hour. For a single sterilizer of this size, therefore, a five-liter reservoir is sufficient, though there is no objection to a larger one. For a battery of ten sterilizers a forty-liter reservoir should be used. One of the ordinary carboys used for commercial acid can be utilized for this purpose. In this case the delivery tube *w* must be joined to a three-way stopcock at E, and the tube *e* must be carried to the bottom of the reservoir to act as a siphon.

Some precautions are necessary in putting this apparatus together. The tube *a* must have an inside diameter of at least 4 or 5 mm. or the water will be held by capillarity, and thus prevent the flow of water by shutting off the supply of air. The siphons T, T, T should be small (3 mm. inside diameter) or the air driven out of the water by heat will collect in the bend and in time prevent the passage of water. If the diameter is small the bubbles of air will be carried through by the stream of water. The ends of these siphons should be contracted sufficiently to allow of their being turned openings down without losing the water they contain, in order to facilitate putting them in place.

Zoölogical Laboratory, University of California. FREDERIC BIOLETTI.

The new Museum building of the New York Botanical Gardens contains one room built in such a way that no light can enter, and here Dr. McDougal will continue his experiments on the effects of darkness on plant growth.

Bibliographies.

When beginning the special study of any subject, a knowledge of its literature is among the first requirements. Some references may be found in the list of papers referred to by various articles on allied subjects, but a more complete knowledge may be obtained from some of the periodicals that pay particular attention to the cataloguing of scientific literature as it is published.

In the *Zoölogischer Anzeiger*, topics are referred to under the branch of the animal kingdom to which they belong. For example, references to literature on the amœba would be found in the *Inhaltsübersicht* under the heading *Protozoa*. Opposite this heading a series of numbers refers to pages on which are given the titles of papers treating of the protozoa, with the name of the periodical in which the paper is printed, the date, and the number of pages and plates.

The library of the Surgeon-general's office, U. S. Army, contains an extensive scientific literature. Subjects and names of authors are printed together alphabetically in the index catalogue—under the author's name, the title of every paper in the library that he has written, and among the sub-heads of any subject, as for example, *cornea*, the title of every paper on that subject.

The *Index Medicus*, issued every month, gives a catalogue of the medical and biological literature of the world. (Discontinued since April, 1899.)

The *Ergebnisse der Anatomie und Entwickelungsgeschichte*, by Fr. Merkel and R. Bonnet, classifies subjects into different departments in which are given the titles of papers, where and when published, and a critical review of them.

The *Archiv für Anatomie und Physiologie* (Leipzig) is published in two parts: (*a*) the *Archiv für Physiologie*, by Du Bois-Reymond; and (*b*) the *Archiv für Anatomie und Entwickelungsgeschichte*, by His and Braune.

Under this name the series dates back to 1877, and from that is continued down to 1795, through the periodicals, *Archiv f. Anatomie, Physiologie u. wissenschaftliche Medicine*, by Reichert u. Du Bois-Reymond (Leipzig), 1876–1859; the *Archiv f. Anatomie Physiologie u. wissenschaftliche Medicine*, by Joh. Müller (Berlin), 1858–1834; *Archiv. f. Anatomie u. Physiologie*, by Joh. Friederich Merkel (Leipzig), 1833–1826; *Deutsches Archiv f. die Physiologie* (Halle and Berlin), 1825–1815; *Archiv f. die Physiologie*, by Joh. Christ, Reil u. J. W. Autenrieth (Halle), 1814–1795.

The *Concilium Bibliograpicum* publishes a catalogue of current scientific literature which may be had on cards, or in a cheaper edition printed on durable brown paper. The bibliographical part of the *Zoölogischer Anzeiger* is continued in this. The cards may be obtained from the Bibliographical Bureau at 38 Eidmattstrasse, Zürich-Neumünster, and the book edition from the publisher, Wilh. Engelmann, in Leipzig, or through a book dealer.

The decimal system is used for the catalogue, and parts referring to special topics may be ordered separately.

The Bibliographical Bureau will also undertake to do any special work for which it is fitted, charging at the rate of 1.25 fr. per hour, or part thereof, for the time spent, and if cards are sent they will be charged at the rate of 2 fr. per

hundred. The bureau requests zoölogists and all publishing bodies to see that their publications reach some Zurich library, or are sent directly to the bureau.

On account of the many publications useful in different departments of bibliographical work, no attempt is made at completeness in referring to them, but a fairly complete list of all the periodicals published may be found in Vol. 40 of the Smithsonian Miscellaneous Collections.

A card catalogue is a convenient way of keeping the references found. Slips of paper, or the regular library cards may be used, and the author's name, the title of the paper, the journal in which it is published, with the date, arranged below each other, as in library card catalogues.

In writing a report of an investigation, a favorite method is to divide the subject matter into topics, each treated under its own heading. In this way parts of the paper referring to the history of the subject, methods, different parts of anatomy of the form studied, etc., may be referred to directly, while a summary at the end gives a *résumé* of the important points embodied in the report. Placing the summary first is an innovation which has the advantage of allowing the reader to test the author's conclusions as he follows the results upon which they are based. If the paper is long, an outline of the subject, with the pages where the different topics may be found, is usually printed at the beginning.

When only a few authors are referred to, it is simpler to enclose the title of the article in a parenthesis, or to place the title at the bottom of the page and refer to it by number, but when there are several references they are usually placed together at the end of the paper, under the heading *Bibliography*. Reference to these titles may be made by a numeral following the author's name, but a more common method is to use the last two numbers of the year in which the paper is published; for example, *Gegeubaur*[87], would refer to 1887, *Gegenbaur, C., Die Metamerie des Kopfes und die Wirbeltheorie des Kopfskeletes. Morph. Jahrb.* **13**: *pp.* 1–114. This may be placed on one line, or the name of the author may be placed above at the beginning of a line, and the date, title, etc., on the line below.

E. M. Brace.

The Antipodal Cells in the Embryo-sac of Grasses.

The antipodal cells of the embryo-sacs of such plants as *Lysichiton* and *Sparganium*, and most of the grasses, form, either before the fertilization of the egg or subsequent to it, large cell complexes. In the grasses this multiplication of the antipodal cells takes place in the regular development of the embryo-sac before fertilization, and can be readily demonstrated if some care is used in collecting, fixing, and imbedding the ovaries to be studied. For this purpose it is best to select grasses which have large ovaries, and which for obvious reasons are at hand. The common grains, as wheat or oats, answer very well, but I have used the flower of the wild oat (*Avena fatua*), which is especially abundant in this vicinity, and I have found it satisfactory.

For the study of the fully developed embryo-sac, ovaries should be selected

the stigmas of which protrude from the paleæ of the grass flower. Thin slices of the ovary should be removed from the dorsal and ventral sides, or the cuts should be made parallel to the two stigmas, care being taken not to cut too deeply. This insures the more rapid penetration of the fixing and the imbedding agents. The bases of the stigma should be retained as a guide for orienting the specimen when in the paraffin bath.

The specimens may be fixed in the ordinary way. I find hot solutions most satisfactory, as they penetrate quickly, and I employ either corrosive sublimate in alcohol or chromic acid. The specimen should be gradually worked up through the alcohols, through mixtures of absolute alcohol and xylol of different proportions, into xylol and paraffin, and at last into paraffin. In each and all of these changes sufficient time should be given to insure thorough penetration.

The proper manipulation of the grass ovaries in the paraffin bath is the most important part in their preparation for study. I use paraffin of two melting points—43°C., and a mixture of 72°C., and 54°C. The specimens are placed in the 43°C. paraffin first, and allowed to remain in it two days; they are then transferred to the mixture of harder paraffins, and they are left in this bath two days longer. The specimens should be kept in the paraffin at as nearly its melting point as possible; if this precaution is taken no harm is done if the ovaries remain in the bath longer than the time stated. The ovaries are composed of such small cells, which are densely filled with protoplasm, that a shorter time in the paraffin may not insure perfect penetration.

Upon removal from the paraffin bath the ovaries may be cut in the usual manner. Longitudinal sections cut at right angles to the stigmas show the antipodal complex, which in *Avena* consists of 36 cells or more, and the egg apparatus as well, and make very satisfactory preparations. These may be stained in the usual way. I find, however, that Haidenhain's iron-alum-hæmatoxylin differentiates the nuclei and cytoplasm in a very beautiful manner.

WILLIAM AUSTIN CANNON.

Stanford University.

MICRO-CHEMICAL ANALYSIS.

II.

THE ARRANGEMENT AND EQUIPMENT OF THE LABORATORY.

So much has been written concerning the arrangement of laboratories for work with the microscope, and so hackneyed has this subiect become that it is with considerable hesitation that the writer ventures to express his opinions and suggest a few innovations. While these suggestions may, perhaps, be old and possibly not original with the writer, it is hoped that they may contain a few ideas which will be of aid to other workers, especially to the tyro in microchemical analysis.

The fact that the microscope has not yet won for itself, in American chemical laboratories, the position to which it is justly entitled is, it would seem, sufficient cause for the *raison d'être* of the present series of articles. Moreover, the number of inquiries following the publication of the first article of the series

—"A Microscope for Micro-Chemical Analysis"—is evidence enough to demonstrate that there are many who are interested in this neat and elegant system of qualitative analysis and who are desirous of obtaining more information.

The idea of establishing a laboratory for micro-chemical analysis at Cornell is largely due to that indefatigable investigator, Dr. H. Behrens, without whose aid, advice, and support the writer would, doubtless, have hesitated to introduce such an innovation into the already extensive courses of study of a chemical department. It gives him great pleasure, therefore, to acknowledge his many obligations to his friend and teacher. It is greatly to be desired that others may be induced to take up, promote, and perfect the system first made practical by the eminent professor at the Polytechnic School of Delft.

If there can be said to be one point more essential than all others in micro-chemical analysis, it is certainly that of proper light. There can be no question that daylight is to be preferred to all other sources of light and, as in all micro-

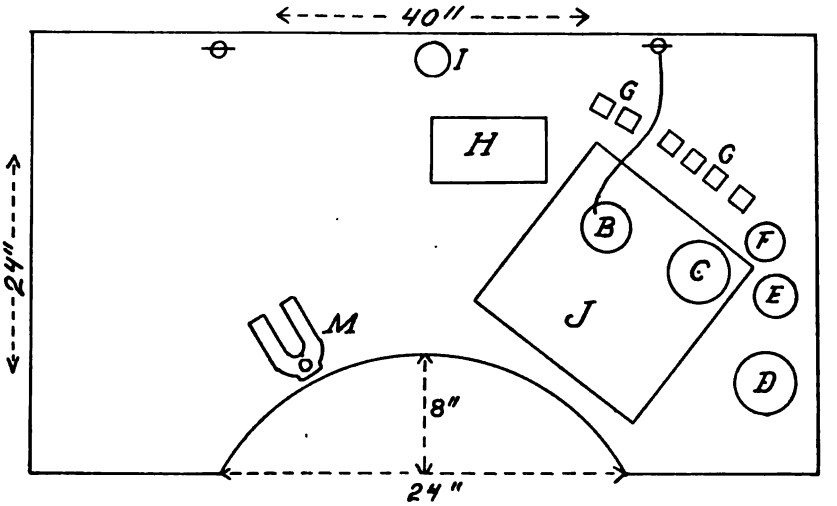


Fig. 1. Diagram of Table-top.

M, Microscope. B, Bunsen burner with side flame. C, Crystallizing dish with water in which rods, etc., are dipped to clean them. D, Dish for waste. E, F, Cylinders for holding glass rods, platinum wires, pipettes, spatula, etc. G, Dropping bottles for acids, distilled water, etc. H, Block of wood with tubes for reagents. I, Welsbach burner. J. Square of plate glass.

scopical work, light from the northern sky is best. While it might be going too far to say that daylight is essential, it may be said that all yellow lights are to be avoided, since it is often necessary to decide upon the color of a compound as well as to note its crystalline appearance. Moreover, in the majority of cases these colors are such that they are not to be distinguished in ordinary gas or lamp light.

The light furnished by the Welsbach, or other so called incandescent gas burners, is fairly satisfactory. A burner of this character placed on the work table will be found a great convenience, especially for illumination on dull days when working with crossed Nicols, or testing over the polarizing prism for pleochroism.

Tables.—In the laboratory at Cornell University the tables have been placed

Fig. 2. Table for Micro-Chemical Work.

directly in front of large windows, thus assuring a liberal supply of light. The tops are of wood forty inches by twenty-four inches, sand-papered smooth and painted a "dead" or "flat" black, this having been found on trial to be the most convenient background upon which to work. To facilitate manipulations, give an increase of working space, and afford a protection to the microscope during evaporations, treatments with acids, etc., the table tops are cut out in the arc of a circle (see Figs. 1, 2, 3). This "cut-out" is made seven to eight inches deep by twenty-four inches wide and possesses several distinct advantages over a straight edged table, as has just been noted. The operator is enabled to obtain a better rest for his arms, hence there is less fatigue during long manipulations. The most important result accomplished, however, by this arrangement is that the

Fig. 3. Table for Micro-Chemical Work.

microscope, although close at hand, is practically removed at a distance from chemical operations. For if the instrument is placed on one side of the cut out portion and the micro-burner on the opposite side, a worker seated on a stool has only to make a slight turn to be in position to conveniently carry on all evaporations, solutions, additions of reagents, etc. In this positon his microscope must necessarily be almost at his back and is thus protected from any chance spurting or splashing of reagents; accidents which are sure to happen from the occasional breaking of slides in heating, the dropping of liquids, etc. A turn in the opposite direction brings the microscope in position to be used instantly. The relative situation of burner, microscope, reagents, and apparatus can be readily understood by reference to the accompanying figures. Fig. 1 is a diagram showing the arrangement of apparatus on a student's table and will aid

in identifying the articles shown on the table in Fig. 2. Fig. 2 is from a photograph of a student's table arranged so as to accommodate two students. Fig. 3 gives a view of the work table of the writer, where more drawer room and more work space is provided.

There can be no doubt that a table top of glass is greatly to be preferred to wood, but the cost of this material, particularly if constructed as described, is such that it is, in most cases, clearly out of the question. The desirable features of a glass top are not important enough to justify any such expense. In order to protect the table tops a piece of heavy plate glass ten inches square is placed under the burner used for heating. In addition this square of glass supplies a convenient resting place for slides which must be allowed to stand a few minutes for the development of crystals. In such cases the slip is allowed to project slightly over the edge of the plate glass; it can then be easily grasped with the fingers and lifted at the proper time. The picking up of slides which are placed flat upon the table is always a matter of annoyance.

Microscope.—A convenient and relatively inexpensive instrument has already been described by the writer.* The essential requirements to be met by an instrument for this class of work are—a low stand, continental type to be preferred, provided with coarse and fine adjustment; rotating stage graduated into degrees; substage with polarizing Nicol prism which can be easily swung aside; plain and convex mirrors, on swinging bar for oblique illumination. The objectives should be of long focal distance; the eyepieces, cross-haired and provided with a stud for lining them. The analyzing Nicol can either slide in and out the tube of the microscope or fit over and above the eyepieces. It is desirable that the position of crossed Nicols be indicated in some way so as to avoid the delay required for adjustment. A magnification of about 20 to 500 diameters will be required. A micrometer eyepiece will be found useful and if drawings are to be kept in the notebook for reference, some form of camera lucida which can be used with the microscope in an upright position will be found invaluable. If a study is to be made of alloys and opaque bodies, a vertical illuminator is desirable.

Of the instruments on the market which can be utilized for micro-chemical analysis and which have been placed at reasonable prices, four may be selected as being the most satisfactory. These are made by:

Bausch & Lomb Optical Co., Rochester, N. Y.
W. & H. Seibert, Wetzlar, Germany.
R. & J. Beck, London, England.
Voit & Hochgesang, Göttingen, Germany.

Cornell University. E. M. CHAMOT.

Professor Card of the R. I. Experiment Station has tried growing rhubarb in the dark. Rhubarb grown in this way has very small cherry-colored leaves, those grown at low temperature being the most brilliantly colored. It is well known that seaweeds growing at such depths that little light can reach them have brilliant colors.

* Jour. App. Micros., Vol. II, p. 502.

The Bacteria in the Stomach of the Cat.

JULIUS WEISS.

III.

THE BEHAVIOR OF BACTERIA IN THE PRESENCE OF DIFFERENT STRENGTHS OF COMBINED AND FREE ACIDS, ASSOCIATED IN DIGESTION.

In a previous paper an attempt was made to give a brief review of the literature bearing on the bacteria that have been isolated from the stomach of man or animal. The review was then followed by a brief description of the methods employed and the bacteria isolated in the present examinations of the cat's stomach.

In this paper, similarly, will be given, first, a review, in chronological order, of the more important investigations that have hitherto been made, with reference to the behavior of bacteria in the presence of acids, especially those acids that are associated in digestion, and then add the results obtained in this respect in my own investigation.

The beginning of earnest work in this field dates back to only 1884. In that year a convention was held in Berlin to discuss the all-absorbing question of that period, the "Cholerafrage." It was on this occasion that Koch (28) announced his discovery of the comma bacillus, which he claimed to have found in the evacuations of individuals who suffered with that disease. This announcement led to a series of experiments by various investigators of that time and by himself, to determine various points, one of which was to test the behavior of this organism in media of different acid concentrations.

Koch found that this bacillus is killed in the normal stomach. But in case of functional derangement of this organ, they could be found both there and in the intestines.

In his text-book, entitled "Principles of Bacteriology," Abbott mentions a few experiments that have been made with the comma bacillus by Kitasato (29) and Nicati and Rietch (30). Kitasato found that at 22°C. the development of this organism was arrested by HCl of .066–.08 per cent. strength. Nicati and Rietch found, as did Koch, that this organism was killed.

Since these experiments great interest has been centered upon the action of HCl upon various species of bacteria that may be found in the stomach. This interest resulted in a number of experiments, more or less important, by different investigators, in England and on the continent.

Before the experiments of Koch were reported, however, Falk and Frank, individually, already experimented, the first with anthrax only, and the last with both anthrax and tubercle. Their experiments, however, are of minor importance.

The following table indicates the results obtained by Falk (31) in 1883:

	Gastric Juice.	11% HCl.	Bile.
Anthrax (spleen)	+	+	—
Anthrax spores	-	=	—

+Destroyed. —Not destroyed. =Rendered inactive.

Frank (32), in 1884, working with anthrax and tubercle, obtained the following results:

	.3% HCl. 1% Pepsin.	.12% HCl.
Anthrax		—
Tubercle	—	

He does not, however, specify whether or not he worked with the spores of these organisms.

Miller (33), in 1885, performed an experiment upon dogs. He fed four of these animals with meat, bread, milk, and sugar, adding in each case 40 cc. of a bouillon culture. He killed the dogs after two and one-half, six, and eight hours, respectively, after feeding, and made plates with 1 cc. of the stomach contents from each. In the first case he obtained 8000 colonies, in the fourth none. He concluded from this that bacteria can live six to eight hours in the stomach of a healthy dog.

In 1886, he (34) again experimented, this time to find out a little more definitely the resisting powers of bacteria towards hydrochloric acid. For this purpose he inoculated bacteria into a sterile mixture of 75 parts of bread and 25 parts of milk, which he kept at body temperature throughout the experiment. To this mixture he added HCl acid gradually, until at the end of two hours the mixture was .2 per cent. acid. Plates were made from time to time, and from the results obtained he came to the following conclusions: Bacteria swallowed at the beginning of a meal can escape the action of the gastric juice, and pass into the intestines; swallowed two or three hours later, only the more resistant ones can escape this action.

McFayden (35), in 1886, experimented with definite species to find out their resisting powers in different percentages of HCl and bile acids and salts. The table on page 724 indicates the results he obtained.

The following is a condensed statement of the conclusions he reached from his investigations:

1. Gastric juice is not an entirely efficient protector against the entrance of bacteria from the stomach into the intestines.

2. Bile acids have a limited action on the bacteria, being very weak towards the putrefactive organisms.

3. The organic acids of the chyme are positive antiseptic factors towards many of the intestinal bacteria.

Van Puteren (18), in 1888, in his investigation with reference to the micro-organisms in the stomach contents of infants, observed that there was a constant increase in the acidity of the stomach contents for the first eighty minutes from the time of ingestion of the food. He also claimed to have observed that the micro-organisms did not decrease in numbers for the same period.

Abelous (19), in 1889, found that many of the organisms he isolated could resist the action of a .17 per cent. HCl solution for a considerable time.

Straus and Wurtz (36), in 1889, experimented with gastric juice and HCl, respectively, to test the germicidal power of each.

They found that freshly drawn gastric juice was rich in micro-organisms, but that these kept decreasing in number from day to day, until, on the eighth day,

Action Four Hours.	HCl.				Taurocholic Acid.			Taurocholate of Soda.				Glycholic Acid.		Acetic Acid.		Butyric Acid.		Lactic Acid.	
Per cent.	.1	.2	.3	.4	.2	.5	1	.5	1	2	5	.2	.5	.1	.2	.1	.2	.1	.2
1. Staph. aureus	O	O	O	+	+	+	+	+	+	+	+	O	+						
2. Typhoid bacil.	O	O	O	+	+	+	+	O	+		+	O	+	+	+	+	+	O	+
3. M. tetragenus	O	O	+	+	+	+		+		+			+	+	+	+	+	+	+
4. Anthrax bacil.	O	+	+	+															
5. Rabbit septic.	O	+	+	+															
6. Comma bacil.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
7. Finkler and Prior	+	+	+	+															
8. Saproph. bacil.	O	O	+	+	O	O	O	O	O	O	+	O	O		+	+	+	O	+
9. M. prodigiosus	+	+	+	+															
10. Blue pus bacillus					O	+	+	O	O	O	+	O	O	+	+	+	+	O	+
11. Proteus vulgar.					O	O	O	O	O	O	+	O	O						
12. Emmerich's bacillus					O	O	+	O	O	O	+	O	O						

the liquid became absolutely sterile. By inoculating plates with gastric juice that was one day old, innumerable colonies developed; with gastric juice four days old, they obtained 675 colonies; finally, with the same liquid, eight days old, no colonies at all made their appearance on the plates.

They also tried the action of the gastric juice, in its non-diluted form, upon the tubercle bacillus, with the following results:

A culture of the tubercle, which had previously been acted upon by the gastric juice for six hours, at 38°C., when inoculated into a guinea pig subcutaneously, produced in that animal all the lesions characteristic of tuberculosis, and finally caused the death of the animal.

A similar injection with a culture which had previously been acted upon for eight to twelve days, produced only a local abscess, which was followed by the disappearance of the lesion and all the bacilli.

Finally, a subcutaneous injection with a culture that had first been subjected to the action of the gastric juice for eighteen to thirty-six hours, produced no lesion whatever, showing that all the bacilli had been killed.

They also experimented with different strengths of hydrochloric acid upon typhoid and cholera bacilli and upon anthrax. The following table indicates the results they obtained:

	Anthrax.			Typhoid.			Cholera.		
Hours of action.	1	2	3	1	2	3	1	2	3
.9 per cent. HCl . . .				O	O		O	O	O
1.7 " " " . . .				O					
3.0 " " " . . .									

Gillespie (41), in 1893, made the statement that in the latest stages of digestion the total free acid in the stomach is only between .05 to .1 per cent., and that the percentages of free acid are considerably lower than these figures, in the earlier stages of digestion. An experiment made by himself, however, briefly described a little later, contradicts the above statement.

He experimented with a number of definite species of bacteria, to find out the resisting powers of each in different percentages of HCl. To obtain different degrees of acidity, he put into each of a number of cylinders 300 cc. of dilute HCl, varying the strengths of the acid in such of the cylinders as he saw fit. In an equal number of parchment U tubes he placed sterilized culture media and pepsin, and inoculated the same with definite species of bacteria. Each of these tubes was then placed in one of the above cylinders, and the entire apparatus kept in an incubator at 38° to 40°C. for a certain length of time. The acidities within the tubes were allowed to regulate themselves by means of osmosis. The percentages of acid within the cylinders and the U tubes and the vitality of the organisms were then tested from time to time, with the following results:

Organism.	Per cent. HCl in the cylinder.	Total acidity in the U tube.	Free acid in the U tube.	Lactic acid present.	Hours of resistance.
B. coli communis	.108	.144	O	-	3½
	.054	.144	O	—	3½
	.324	.522	—	-	2½
	.414	.234			1
Leptothrix	.054	.144	Trace		1
	.182	.342	Trace		1½
Lactis aerogenes	.036	.090	O	—	4
	.054	.108	Trace		1¾
	.108	.234		—	½
	.504	.612		—	¾
Proteus vulgaris	.072	.072	O	Trace	¼
	.108	.126	Trace	Trace	1½
	.234	.306	O	Trace	2½
	.520	.376	O	Trace	¼

He performed another experiment on the living subject, as follows: A patient was given a meal of whitefish and bread. Cultivations were then made from samples of his stomach contents, from the first half hour after ingestion, until the fourth hour. The following table shows the conditions from time to time, during the experiment:

Hours after ingestion.	Total acid in stomach. Per cent.	Acid albumin. Per cent.	Free acid. Per cent.	Number of bacteria on plate.
0	0	0	0	Innumerable
1	—	—	—	Innumerable
3	.381	.216	.165	Dimished
4	.342	.090	.252	Two growths

In the summary just given it will be observed that in a number of cases the investigators overlooked the fact that bacteria ingested with the food are first acted upon in the stomach by a very low acid percentage, the strength of the acidity rising only slowly and gradually. This oversight on their part led them to subject the bacteria they experimented with to a concentrated gastric juice or strongly acidified liquids from the start. It will be found, nevertheless, that McFayden, van Puteren, and Gillespie performed their experiments under more natural conditions. McFayden subjected each of his organisms to different strengths of the acids he employed; van Puteren studied the action of the gastric juice upon the bacteria under natural conditions; and Gillespie studied the behavior of the bacteria he experimented with, under both natural and under

artificial conditions, in the last imitating as closely as possible the conditions present in the animal. These three investigators found that bacteria, in the presence of proteids, could resist comparatively high acidities.

In the first part of this investigation, it was seen that during the period when digestion in the stomach was at its height, and when the gastric secretion must have been at its maximum, the number of bacteria obtained from the mucosa under those conditions was vastly greater than the number grown from the stomach of an animal that had been previously fasting twenty-four hours, and in which there was practically no secretion going on.

In order to obtain an explanation of these phenomena, and to get a more definite idea of the relative numerical values of the bacteria that may be found in the stomach at different acid percentages, from time to time, during digestion, I performed a number of parallel experiments in dialyzers, in which the conditions present in natural digestion were closely imitated.

Taking into consideration the slight variation in conditions that were present in each set of parallel experiments performed, the results obtained in all were strikingly similar to one another. This being the case, it will be sufficient to discuss here a single typical experiment.

As the results obtained in experiments of this nature depend very much upon the methods employed, it would be well, perhaps, to discuss this part first.

Albumen and proteids only were employed as materials for digestion, namely, egg-white, egg-yoke, and bouillon.

The bouillon was prepared in the ordinary manner, as directed by Moore (2), except that the peptone was omitted. The omission of this substance, though not essential for the acid determinations, was, nevertheless, a very important step in the experiments dealing with the peptone forming properties of bacteria, as will be seen in Part V of this investigation.

The other materials employed were a 2½ per cent. solution of saccharated pepsin, a .2036 per cent. hydrochloric acid solution, a 1/9.8 N. caustic soda solution, and, as an indicator, a 1 per cent. solution of phenolphthalein.

The dialyzers used consisted of glass cylinders, having tight fitting covers, and each contained a parchment tube, bent into a U form.

The following conditions were present in the experiment under consideration:

Three hundred cubic centimeters of the hydrochloric acid were put into one of these cylinders, and in the parchment tube were placed 100 cc. of the bouillon, 25 cc. of the same bouillon, but in which organisms obtained from a cat's stomach were first grown, and 25 cc. of the pepsin solution. The dialyzer was then put into an incubator, and allowed to remain there at 35°C. for fifteen minutes undisturbed. At the end of this period, and every fifteen minutes thereafter for the first hour, and every half hour for the last three hours, the cylinder was opened regularly, and 1 cc. was removed from the solution in the cylinder, by means of a graduated pipette, and the same was run into a beaker containing 10 cc. of distilled water. Similarly, 2 cc. of the solution in the parchment tube were removed, 1 cc. at a time, one portion serving to determine the total acid percentages present in the tube at the various periods mentioned above, and the second portion served for the determination of acid-albumin, present at the same

	P.M.	Acidity in the Cylinder	Total Acidity	Acid-Albumen	Free Acid	Number of Bacteria per c. c.
1	2.45		.13 086%	.07270%	.05 816%	Innumerable
2	3.00		.17 448 "	.13 086 "	.04 364 "	Very numerous
3	3.15	.16 721%	.21 083 "	.11 632 "	.09 451 "	25 200 000
4	3.30	.16 721 "	.21 083 "	.15 994 "	.05 089 "	20 300 000
5	4.00	.15 267 "	.23 264 "	.15 267 "	.07 997 "	10 150 000
6	4.30	.10 905 "	.23 264 "	.14 540 "	.08 724 "	5 750 000
7	5.00	.11 632 "	.23 264 "	.18 902 "	.04 364 "	5 080 000
8	5.30	.11 632 "	.23 264 "	.13 086 "	.10 178 "	508 000
9	6.00	.11 632 "	.25 445 "	.11 632 "	.13 813 "	339 000
10	6.30	.13 813 "	.21 083 "	.10 905 "	.10 178 "	112 000

Plate 1. Bacteria in the Stomach of the Cat.

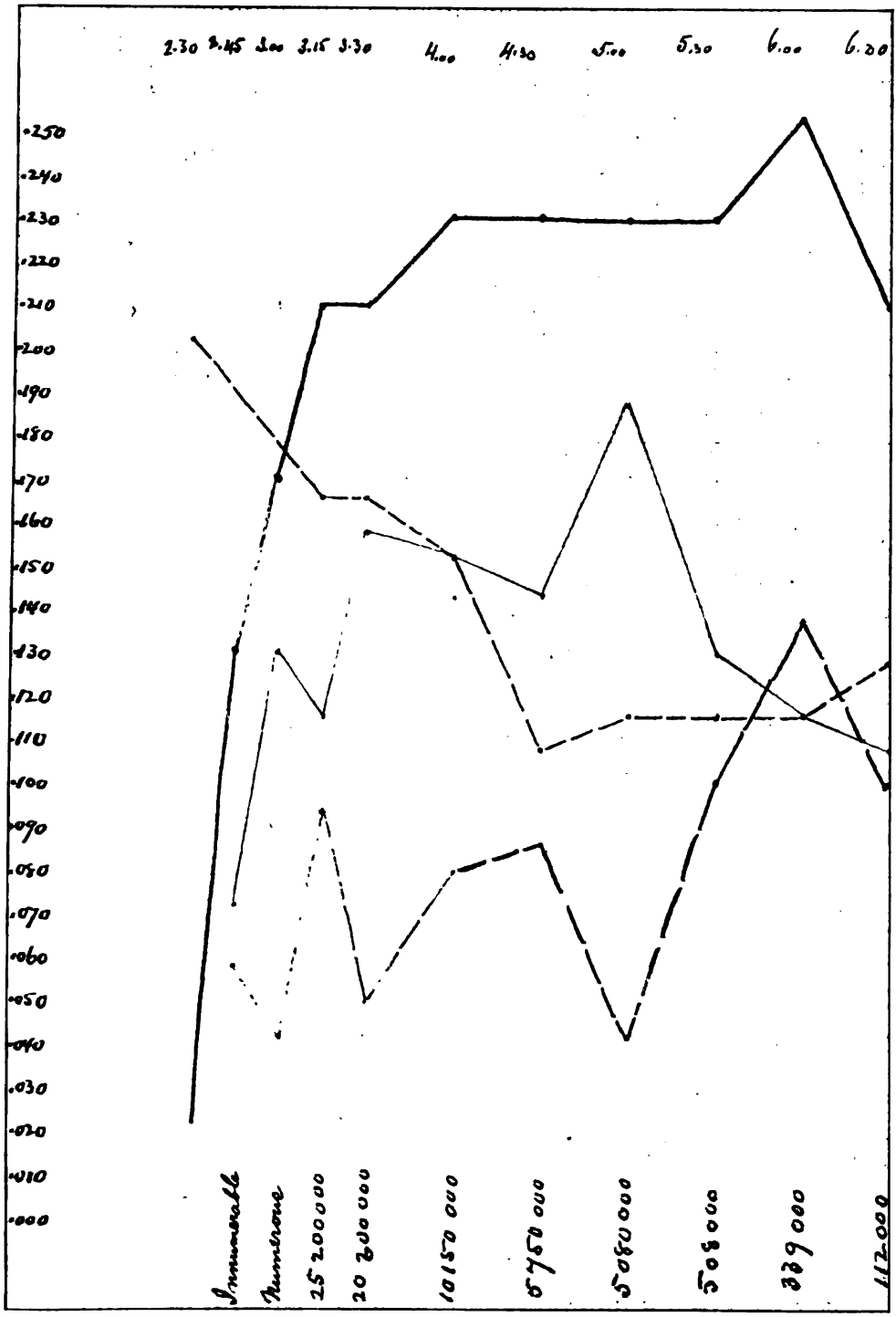


Plate 2. Bacteria in the Stomach of the Cat.

time in the experiment. As these solutions were withdrawn from the U tube, another loopful was likewise withdrawn, and a plate made therewith. This step was repeated each time that the solutions were withdrawn from the dialyzer for the acid determinations.

The number of colonies that developed on each of the plates was counted three days after the inoculations were made. As the value of the loop was known, it was possible to establish a relation between the different acidities obtained from time to time and the bacteria that developed on the plates from the solutions with which they were inoculated at the same intervals.

It will be noted that in the arrangement of this apparatus, two factors were at work, regulating the passage of the hydrochloric acid from the cylinder into the parchment tube: First, the law of osmosis, and second, the presence of proteid material in the U tube. The presence of both these factors, therefore, established conditions approximately similar to those present in the stomach of a carniverous or omniverous animal during digestion. The results obtained in this experiment, therefore, with reference to the relative variations in the number of bacteria present at different acidities during digestion, may be compared to those present in the living subject, bearing in mind, however, other essential differences that exist in natural and artificial digestion.

In the appended table is given a list of the different acidities that were present from time to time, in both the cylinder and in the parchment tube. There will also be found indicated the number of bacteria that was present to a cubic centimeter, each time the tests were made. (See page 730).

From an examination of this table it will be seen that though the number of bacteria decreased two-fifths at the end of one and one-half hours, to one-fifth at the end of two and one-half hours, the important decrease took place at the end of the third hour. It will also be seen, at the same time, that the total acidity in the parchment tube during this entire period, from 4 to 5:30 P. M., was constant, .23264 per cent., but that the free acid present in the tube was greater at 5:30 P. M. than it was at any previous period during the experiment.

The presence of this comparatively high percentage of free acid may, therefore, be taken as the main cause for the marked decrease in the number of bacteria at that period.

It may also be inferred that the combined acid, the acid albumin, is not an important factor as a germicidal agent.

At this stage of the discussion, it will be comparatively easy to explain why it is that during the height of gastric digestion, when the secretion of HCl is at its maximum, the number of bacteria that may be found in the stomach is so much greater than the number to be found in the same situation after twenty-four hours fasting.

The answer is self-evident. During the height of digestion, the HCl secreted becomes greatly diluted by the liquids ingested, and, what is more important, the greatest part of it, if not all, combines with the proteids present, forming acid albumin, a substance that is a very weak germicidal agent.

After the food, however, has passed out from the stomach, or even in the last stages of gastric digestion, though the secretion of HCl is then greatly dimin-

ished, the quantity that is present, nevertheless, is in sufficiently concentrated form to act with great destructive effect upon the persisting bacteria.

Certain species of the organisms that get into the stomach have the power to resist even the concentrated form of the secreted acid, and may be isolated from the gastric mucosa, after they had been subjected to this action for many hours. As examples of such organisms may be mentioned those that were isolated in this investigation, in cats 2 and 3, as micrococcus No. 24, bacillus No. 25, tetrad No. 26, and bacterium No. 28. These bacteria could also be grown from the liquid in the experiment R (Part V), after four hours action of the HCl, which was added in bulk to the organisms, in the presence of egg-white.

The conditions present in this experiment have also been indicated by means of curves in a chart on page 731.

The delicate broken line indicates the acid curve in the cylinder; the heavy line, the curve of total acidity in the U tube; the delicate line, the acid-albumin curve in the U tube; the lower heavy broken line, the free acid curve present in the U tube. The figures at the top indicate the different periods in which the determinations were made; the figures at the left indicate the acid percentages in terms of HCl; and the figures at the bottom, the number of bacteria found during the different periods of the experiment.

THE ACADEMY OF SCIENCE OF ST. LOUIS.—At the meeting of the Academy of Science of St. Louis of February 5, 1900, some 250 persons were given a demonstration of the use of the microscope in the sciences, arts, and industries, by experts under the direction of Dr. H. M. Whelpley, as follows:

Anatomy, Dr. R. J. Terry; *Bacteriology*, Dr. Amand Ravold; *Blood Examination*, Dr. Ludwig Bremer; *Botany*, Mr. H. F. Roberts; *Diseases of Forest Trees*, Dr. H. von Schrenk; *Drug Adulterations*, Mr. O. H. Elbrecht; *Flour Inspection*, Mr. Victor Goetz; *Insects Parasitic on Man*, Mr. C. F. Baker; *Living Protoplasm*, Dr. Otto A. Wall, Jr.; *Microphotography*, Mr. Robert Benecke; *Mineralogy*, Dr. G. Hambach; *Photographic Dry Plate Testing*, Mr. Robert Benecke; *Photomicrography*, Dr. Adolph Alt; *Physiology*, Dr. Hartwell N. Lyon; *Seed Adulterations*, Mr. F. M. Maas; *Spice Adulterations*, Mr. William K. Ilhardt; *Textile Fibers*, Mr. Peter J. Weber, Jr.; *Trichina*, Dr. G. C. Crandall.

Through the courtesy of the Historical Society the rooms of the society were thrown open to the members of the Academy and their guests, and the society's important collections, as well as the demonstration offered by the Academy, proved a source of interest and instruction to the ladies and gentlemen present.

WILLIAM TRELEASE, Recording Secretary.

Crinkled paraffin sections may easily be straightened by putting a drop of water on the slide over the albumen fixative and tipping the slide around until a thin film is formed. Mount the sections on this and place the slide in a warm place. There will be sufficient moisture to allow the paraffin to straighten as it melts, and as the water evaporates from the slide the sections will sink into the fixative and be fastened in position.

METHODS IN PLANT HISTOLOGY.

CHARLES J. CHAMBERLAIN.

XII.

(The photomicrographs illustrating this paper were made from the author's preparations by Dr. W. H. Knap of Chicago. They were taken with a Bausch & Lomb $\frac{1}{12}$ oil immersion lens, and the magnification was 1420 diameters, but the photographs have been reduced one-half for this paper.)

SPERMATOPHYTES.

In this immense group we cannot hope to give even approximately complete directions for making preparations, but must be content to give a few hints which may prove helpful in collecting material and in securing mounts of the more important structures of the flowering plants. We shall consider the gymnosperms and the angiosperms separately, although in many respects the technique is the same for both.

GYMNOSPERMS.

Since *Pinus* is a characteristic type we shall describe methods for demonstrating various phases in the life history of this genus, hoping that the directions will enable the student to experiment intelligently with other forms.

Spermatogenesis.—In October the clusters of staminate cones which are to shed their pollen in the coming spring are already quite conspicuous. The cones should be picked off separately and the scales should be carefully removed so as to expose the delicate greenish cone within. At this time the archesporial cells are easily distinguished. Material collected in January or at any time before growth is resumed in the spring shows about the same stage of development. If it is desired to secure a series of stages with the least possible delay, a branch bearing numerous clusters of cones may be brought into the laboratory and placed in a jar of water. Growth is more satisfactory in case of branches broken off in the winter than in those brought in before there has been any period of rest. The material can be examined from time to time and a complete series is easily secured. The karyokinetic figures in the pollen-mother-cells furnish exceptionally instructive preparations. Staminate cones which will yield karyokinetic figures can be selected with considerable certainty by examining the fresh material. Crush a microsporangium from the top of the cone and one from the bottom, add a small drop of water and a cover to each and examine. If there are pollen tetrads at the bottom, but only undivided spore-mother-cells at the top, it is very probable that longitudinal sections of the cone will yield the figures. If a drop of methyl green be allowed to run under the cover it will enable one to see whether figures are present or not. When desirable cones are found, they should be cut longitudinally into two halves. The later stages, showing the germination of the microspores, furnish better sections if the cones are cut transversely into small pieces about $\frac{3}{16}$ of an inch thick. It is very easy to get excellent mounts of the pollen just at the time of shedding. Shake a large number of cones over a piece of paper, thus securing an abundance of material. Fix in chromo-acetic acid, wash in water (a few

minutes is sufficient and the water need not be changed), pass through the alcohols, allowing each to act for about two hours, make the usual gradual transition from alcohol to xylol, and from xylol to paraffin. It is best that the material should be in a small bottle not more than one-fourth of an inch in diameter, at any rate the pollen should be in such a bottle during infiltration, which should not require more than an hour, although a longer period does no harm if the temperature does not rise above 50°C. Now put the lower portion of the bottle into cold water and thus harden the paraffin as quickly as possible. Break the bottle carefully, cut off the lower portion of the paraffin containing the pollen, mount it on a block in the usual manner and trim away some of the paraffin so that two parallel surfaces will make the sections ribbon well. Material in this stage shows a large tube nucleus, a somewhat lenticular cell with a more deeply

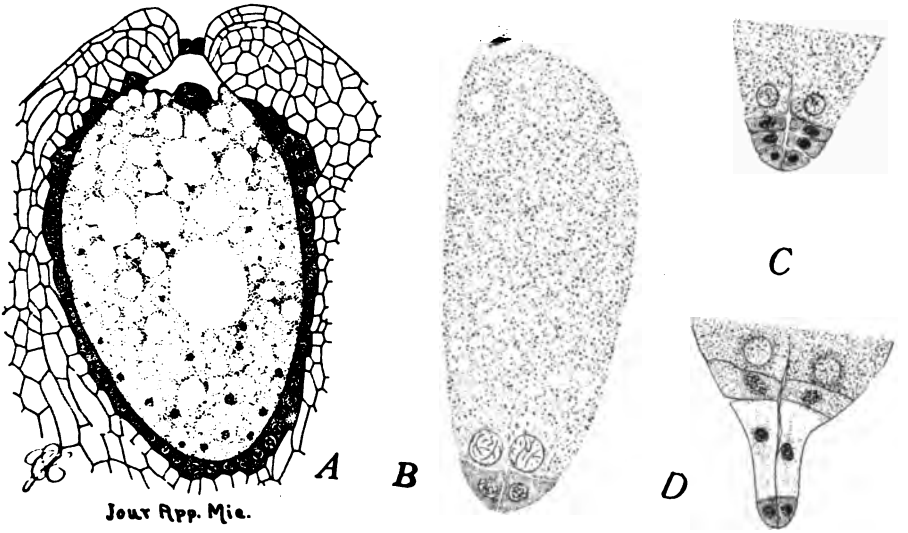


Fig. 1. Pinus laricio. × 104.
A. Top of prothallium with an archegonium just before the cutting off of the ventral canal cell. Fixed in Flemming's weaker solution and stained with Haidenhain's iron alum hæmatoxylin. Collected June 18, 1897. B, C, and D. Early stages in the formation of the embryo. Fixed in chromo-acetic acid, and stained in safranin-gentian violet-orange. Collected July 2, 1897.

staining nucleus, and lastly, two small prothallial cells quite close to the spore wall. The prothallial cells cannot always be detected at this stage and there may be some doubt as to whether two such cells are always present. The division of the lenticular cell into "stalk cell" and "body cell," and also the division of the body cell into the two male cells, must be looked for in sections of the nucellus of the ovule.

Oogenesis.—The entire ovulate cone at the time of pollination is easily cut in paraffin. Longitudinal sections of the cone at this time give good views of the bract and ovuliferous scale bearing the ovules. The integument is very well marked and in the nucellus one or more sporogenous cells can usually be distinguished. As soon as the scales close up after pollination the cone will be too hard to cut and it will be necessary to remove the scales and cut them separately. For a study of the ovule and the structures within it, better preparations will be

obtained by carefully cutting off the pair of ovules from the scale. For preparations like that represented in Fig. 1 A, it is a good plan to remove the endosperm with its archegonia from the ovule. Fixing, infiltration, and cutting will then occasion but little trouble, and the whole ribbon may be gotten upon a single slide. However, at this stage the pollen tubes with their contents are rapidly working their way through the nucellus toward the archegonia, and consequently it is better to retain enough of the tissues of the ovule to keep the nucellus in place. In later stages, after fertilization has taken place, it is necessary to remove the endosperm. In stages like Fig. 1 B, C, D, and later, the developing testa should be dissected away with great care, for a very slight pressure is sufficient to injure the delicate parts within. Mature embryos may be dissected out from the endosperm before fixing, but it is hardly necessary since they cut quite well if left in place. The "pine nuts" or "Pinon" to be found upon the market are good for a study of the mature embryo. The testa, which is quite a hard shell, should be taken off and the endosperm should be allowed to soak in water for about twenty-four hours, after which the embryo may be dissected out and fixed.

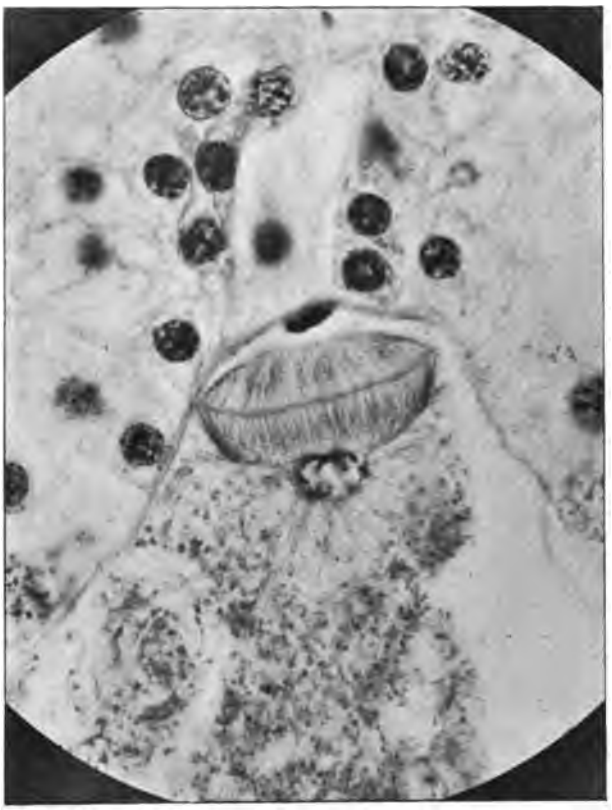


Fig. 2. Pinus laricio. × 710.
The mitotic figure concerned in cutting off the ventral canal cell. The nucleus at the lower end of the spindle is the nucleus of the oosphore. Fixed in chromo-acetic acid, and stained in the safranin-gentian violet-orange combination. Collected June 21, 1897.

The period at which the various stages may be found varies with the species, the locality, and the season. In *Pinus laricio* (the common Austrian pine) at Chicago, in the season of 1897, material collected May 27 did not yet show archegonia; the ventral canal cell was cut off about June 21 (see Fig. 2), the fusion of the pronuclei occurred about a week later, and stages like Fig. 1 B, C, and D were common in material collected July 2. In the season of 1896, all the stages appeared about two weeks earlier. In *Pinus sylvestris* the stages appeared a little earlier than in *Pinus laricio*. After the stage shown in Fig. 1

A has appeared, it is necessary to collect at intervals of not more than two days until the stage shown in Fig. 1 D is reached. If collections are made at intervals of four or five days, the most interesting stages, like the cutting off of the ventral canal cell, fertilization, and the first divisions of the nucleus of the oospore, may be missed altogether. It should be mentioned that all the ovules of a cone will be in very nearly the same stage of development.

A rather strong chromo-acetic acid (one g. chromic acid and one-half cc. glacial acetic acid to 100 cc. water) can be recommended for the entire series in spermatogenesis, oogenesis, fertilization, and formation of the embryo. After repeated trials the popular Flemming's solution does not seem to be at all superior and often fails to give as good results as the cheaper fixing agent.

The following stains may be suggested: for studying the pollen tubes in the nucellus, cyanin and erythrosin; for the development of the archegonium up to the stage shown in Fig. 1 A, Delafield's hæmatoxylin; for the stages shown in

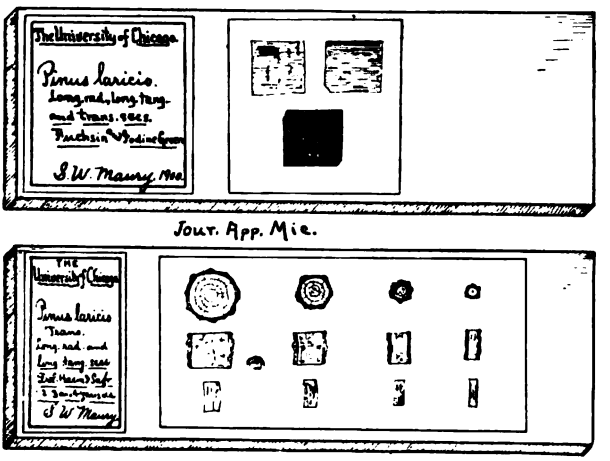


Fig. 3.
Slides showing labels and methods of arranging sections.

Fig. 1 A, iron alum hæmatoxylin or the safranin-gentian violet-orange combination; for the stage shown in Fig. 2, nothing seems to equal the safranin-gentian violet-orange combination; for stages like Fig. 1 B, C, and D, and also for later stages in the development of the embryo, Delafield's hæmatoxylin brings out the walls perfectly, but since mitotic figures are very frequent in these stages it is worth while to use the safranin combination with some preparations, although it is much inferior to Delafield's hæmatoxylin when cellulose walls are to be emphasized.

All the stages which have been described can be cut in paraffin with little difficulty.

The Leaves.—The leaves of our common gymnosperms cut readily in paraffin while they are young and tender, but as they approach maturity it is a fruitless task to attempt paraffin sections. Celloidin sections are far more satisfactory. Cut the needles into pieces, about one-fourth of an inch long, fix in a picro-cor-

rosive-acetic mixture (one-half g. picric acid, two g. corrosive sublimate, one cc. glacial acetic acid, 100 cc. fifty per cent. alcohol). If used hot, five minutes is sufficient, but if used cold it should be allowed to act for two or three hours. After the material has been imbedded in celloidin, the block should be placed in equal parts of ninety-five per cent. alcohol and glycerine for a few days, after which it should cut quite readily. Stain with safranin and Delafield's hæmatoxylin, clear in Eycleshymer's clearing mixture and mount in balsam.

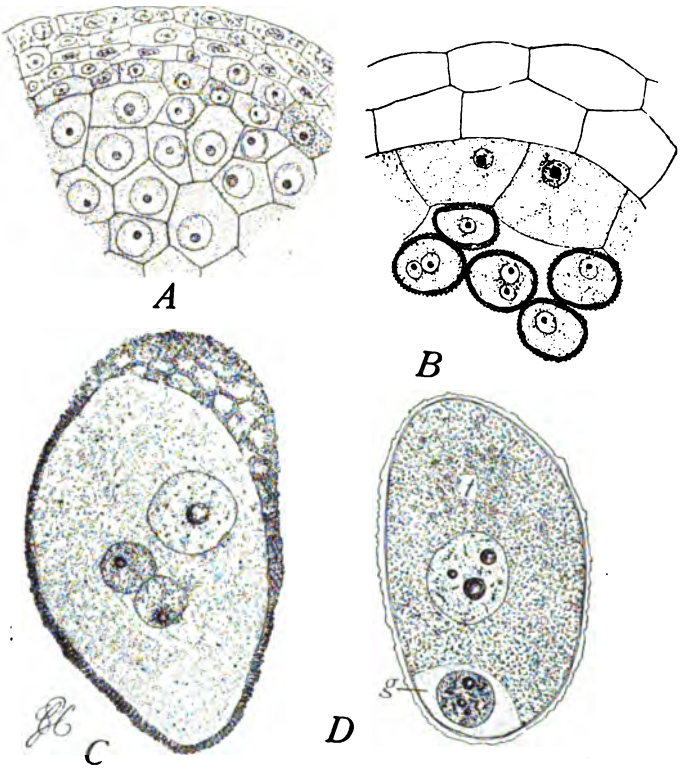


Fig. 4. Salix tristis. ×594.

A. Transverse section of a portion of a young anther showing large sporogenous cells, one layer of tapetal cells (more deeply shaded in the figure), and from three to four layers of wall cells. B. Salix petiolaris. ×594. Small portion of transverse section of a nearly mature anther showing five pollen grains, two tapetal cells and two layers of wall cells. C. Lilium auratum. ×505. Section of a pollen grain showing the large tube nucleus and two smaller generative nuclei. Fixed in chromo-acetic acid and stained in safranin-gentian violet-orange. D. Lilium tigrinum. ×505. Pollen grain showing tube nucleus in the middle and a lenticular cell with the generative nucleus at one end of the grain.

Fairly good sections may be obtained in great quantities with little trouble by the following method: Make a bunch of the needles as large as one's little finger, wrap them firmly together with a string, allowing about an eighth of an inch of the bunch to project above the wrapping; then fasten the whole in a hand microtome and every stroke of the razor will give twenty or thirty sections, some of which will surely be good. As the sections are cut they may be put directly into ninety-five per cent. alcohol and after a few minutes can be trans-

ferred to fifty per cent. alcohol and then to the stain. Dehydrate, clear in xylol, and mount in balsam.

Stems and Roots.—With a sharp razor, fairly good sections of stems and roots may be made without imbedding, especially if the hand microtome be used. Young buds may be cut in paraffin. Stems and roots as large as half an inch in diameter can be cut in celloidin. The material should be cut into pieces not more than one-fourth of an inch long. The following treatment should give good results:

1. Picro-corrosive-acetic mixture, five minutes if used hot, or two to three hours if used cold.

2. Wash in fifty per cent. alcohol to which a little iodine has been added, two hours; seventy per cent., eighty-five per cent., ninety-five per cent., two hours each; absolute alcohol two hours; then change to fresh absolute alcohol, which should act for two hours longer.

3. Ether alcohol, twenty-four hours. Some prefer to precede the ether alcohol by a mixture of equal parts of ether alcohol and absolute alcohol.

4. Thin celloidin (about two per cent.), two or three days; six per cent. celloidin, two or three days; ten per cent. celloidin, two or three days. After the thin celloidin has acted for a few days, the cork may be removed for a short time each day, thus allowing the thin celloidin to become thick by the evaporation of the ether alcohol.

5. Get some small blocks of wood (three-eighths inch cubes of white pine are good), wet one of them in ether alcohol, dip it into thin celloidin, place the object upon the block in convenient position for cutting, pour over it a few drops of ten per cent. celloidin and then plunge the whole into chloroform. Leave it in the chloroform about twenty-four hours and then transfer to a mixture of equal parts of ninety-five per cent. alcohol and glycerine, where it should remain for several days. Material may be kept here indefinitely. Even refractory stems may be cut after they have been in this mixture for a couple of weeks.

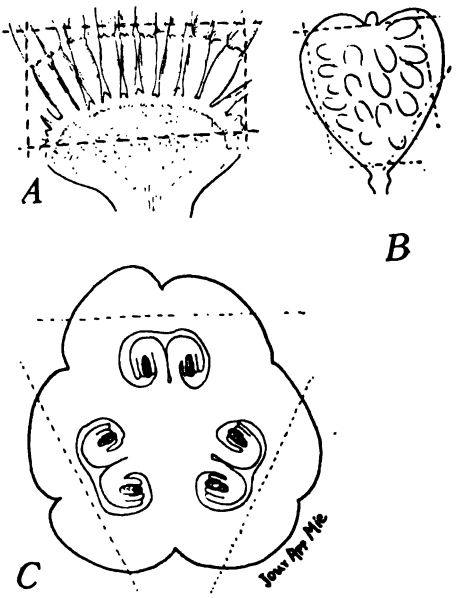


Fig. 5.
A. Head of Aster. B. Pod of Capsella. C. Transverse section of ovary of Lilium. The dotted lines show how the material should be trimmed before fixing.

6. Cut the sections, keeping the knife wet with the alcohol and glycerine mixture. Transfer the sections to seventy per cent. alcohol, then to fifty per cent., and then to the stain.

7. Stain in safranin twenty-four hours, wash in thirty-five per cent. alcohol about a minute, stain in Delafield's hæmatoxylin five to ten minutes, wash in

water two minutes, thirty-five per cent. alcohol two to five minutes, fifty per cent. alcohol two to five minutes, acid alcohol one to ten seconds, seventy per cent., eighty-five per cent., ninety-five per cent., about two minutes each, Eycleshymer's clearing mixture until cleared, usually about one or two minutes. Mount in balsam.

Xylem should show a brilliant red color and cellulose a rich purple if the stain is successful. If either stain is too weak or too prominent, the duration of the stain, the length of time in the alcohols, or the time in acid alcohol must be varied until the desired result is secured.

People who make all their anatomical sections without imbedding may regard this method as tedious and unnecessary, but such preparations will show much which is never seen in mere free hand sections for the reason that free hand sections, if thin enough to show any detail, will lose most of their cell contents, while in celloidin sections everything is held in place. Even if the celloidin sections be passed through absolute alcohol and cleared with clove oil, a process which dissolves away the celloidin, the contents of the cells will still be retained in most cases, and stains which cannot be extracted from celloidin may be used. However, we prefer to use the safranin and Delafield's hæmatoxylin and retain the celloidin since this combination can be extracted completely from the celloidin and still leave the object brilliantly stained.

For preparations of the mature wood a piece of white pine from a dry goods box furnishes perfect material. It should not be imbedded, but the cutting will be facilitated if the piece be soaked for a few hours in water or in the alcohol and glycerine mixture. In all preparations designed to show the structure of wood there should be three sections—a transverse, a longitudinal radial, and a longitudinal tangential. These may be arranged as in the upper slide of Fig. 3, but if it is desired to make a thorough study of the structure, it is a good plan to have on each slide several sections of each kind, thus having an opportunity to use a variety of stains. Fuchsin and iodine green is a good combination. The safranin and Delafield's hæmatoxylin is also excellent.

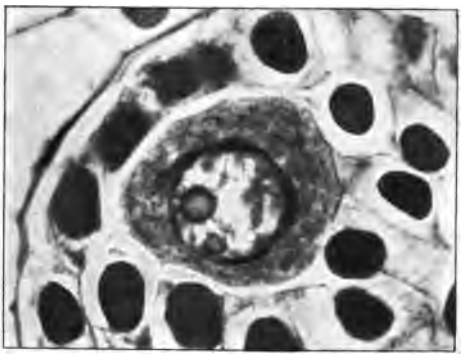


Fig. 6. Lilium philadelphicum. ×710.
Apex of nucellus contains a large archesporial cell with a large nucleus. In Lilium this archesporial cell becomes the embryo sac directly without cutting off any tapetal cell or dividing into potential macrospores. Fixed in chromo-acetic acid and stained in Delafield's haematoxylin.

For a study of young stems or roots, preparations like that shown in the lower slide of Fig. 3 will be found very convenient.

ANGIOSPERMS.

Success depends largely upon judgment and care in selecting and trimming material before it is put into the fixing agent in the field. While the following directions cannot be applied to all plants, they should, nevertheless, enable the

student to make such modifications as may be demanded by any particular form.

Floral Development.—For a study of floral development very young buds are necessary and it is best to select those forms which have rather dense clusters of flowers in order that a complete series be obtained with as little trouble as possible.

The usual order of appearance of floral parts is (1) calyx, (2) corolla, (3) stamens, and (4) carpels, but if any of these organs are reduced or metamorphosed, their order of appearance may be affected.

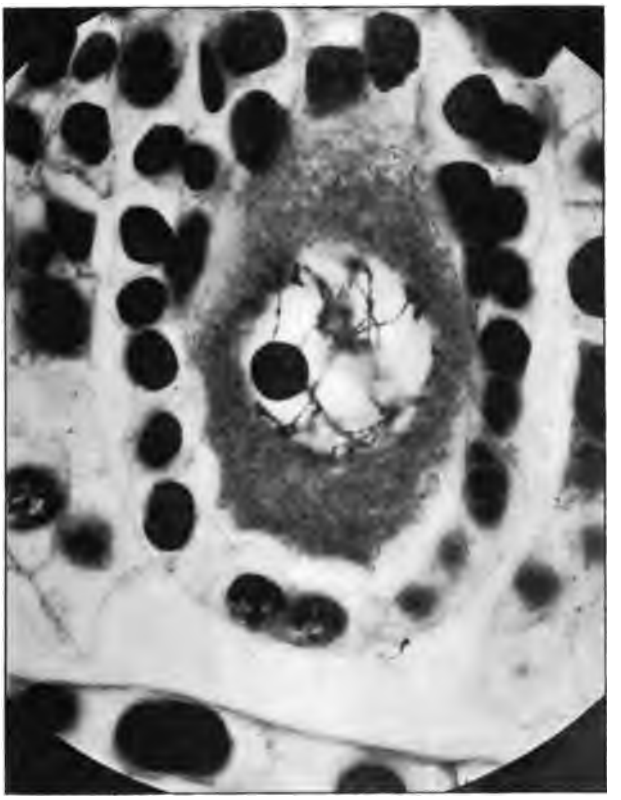


Fig. 7. Lilium philadelphicum. × 710.
Nucellus with macrospore. The chromatin thread in the nucleus is very distinct. Fixed in chromo-acetic acid and stained in safranin-gentian violet-orange.

Floral development is easily studied in the common *Capsella bursa-pastoris.* Take the tip of a vigorous shoot and cut away those flowers whose pedicils have reached an eighth of an inch or more in length, thus leaving a piece not more than one-fourth of an inch in diameter and three-eighths of an inch long. Fix in chromo-acetic acid and stain in Delafield's hæmatoxylin. The sections should be longitudinal and not more than 10 μ thick.

The common dandelion, *Taraxacum officinale*, affords an excellent series with little labor. Examine vigorous plants which have, as yet, no flowers or buds in

sight. Dig up the plant and dissect away the leaves. If there is a white cluster of flower buds, the largest not more than three-sixteenths of an inch in diameter, cut out the cluster, leaving only enough tissue at the base to hold the buds in place. Fix and stain as in *Capsella*.

The Canada thistle, *Cnicus arvensis*, shows the floral development with unusual clearness, but the preparation of the material is more tedious. The involucre, which is too hard to cut, must be carefully dissected away. After a series of sizes has been selected, the rest of the process is easy and the preparations are worth the trouble.

In the willows, *Salix*, the bud scales must be removed and the copious hairs

Fig. 8. Lilium philadelphicum. × 710. Fig. 9.
First division of the nucleus of the macrospore. (The same nucleus the earlier stages of which are shown in Figs. 6 and 7.) Fixed in chromo-acetic acid, and stained in safranin-gentian violet-orange. Fifteen microns.

should be trimmed off as much as possible with scissors, after which the catkin should be cut in two longitudinally and placed in the fixing agent.

Spermatogenesis.—The earlier stages in spermatogenesis will be found in the preparations of floral development. For tracing the nuclear changes involved in this process the lilies furnish very good material because the cells and nuclei are exceptionally large. Several species of *Lilium* are common in greenhouses, and these may be used where wild material is not available. In early stages where the sporogenous cells have not yet begun to round off into spore-mother-cells it is sufficient to remove the perianth, retaining just enough of the receptacle to hold the stamens in place. Transverse sections show the six stamens and also

the young ovary. After the spore-mother-cells have begun to round off, each stamen should be removed so as to be cut separately. It is very desirable to secure stamens showing the mitotic figures which occur during the division of the spore–mother-cell into the four microspores. Since the pollen-mother-cells are apt to be in approximately the same stage of development throughout the anther, it is worth while to determine whether mitotic figures are present before putting the material into the fixing agent. The procedure indicated for Pinus can be followed here. It is not necessary to cut the stamens into pieces before fixing since they are easily penetrated and infiltrated; in later stages the stamens *must* not be cut into pieces since the pollen grains are easily washed out.

Transverse sections are better for morphological purposes; but where nothing is desired except the development of pollen grains from the spore-mother-cells, much more material can be gotten under a cover by using longitudinal sections.

For early stages up to that shown in Fig. 4 A, Delafield's hæmatoxylin is very satisfactory; in stages like B, C, and D of the same figure, cyanin and erythrosin often give excellent differentiation, the tube nucleus taking the erythrosin, and the generative nucleus the cyanin, while the starch grains which are often abundant at this stage take a faint pink from the erythrosin. However, the safranin-gentian violet-orange combination shows nuclear details to better advantage and readily distinguishes the tube and generative nuclei, although it does not give such a striking color contrast as the cyanin and erythrosin. The starch grains are brilliantly stained by the gentian violet.

The mature pollen grains, after shedding, may be prepared by the method already described for Pinus.

In oogenesis, as in spermatogenesis, the early stages will be found in preparations of floral development. The origin and development of the macrospore are easily traced in *Lilium*. In very young stages, before the appearance of the integument, the ovary may be removed from the flower and placed directly in the fixing agent, but in later stages, such as are shown in Figs. 7–12, strips should be cut off from the sides of the ovary in order to secure more rapid fixing and more perfect infiltration with paraffin. The dotted lines in Fig. 5 C show about how much should be cut off.

Fig. 10. Lilium philadelphicum. × 710.

Macrospore (embryo-sac) containing two daughter nuclei resulting from the first division of the nucleus of the macrospore. A portion of the spindle still remains between the two nuclei. Fixed in chromo-acetic acid, and stained in safranin-gentian violet-orange. Fifteen microns thick.

This is a much better plan than to secure rapid fixing and infiltration by cutting the ovary into short pieces because the ovules will be in about the same stage of development throughout the ovary, and when one finds desirable stages like those from which these micrographs were taken, it is gratifying to have these pieces as long as possible.

In lilies and other forms, with large cells, the entire series shown in Figs. 6–11 may be fixed in chromo-acetic acid and stained in safranin-gentian violet-orange, but stages earlier than that shown in Fig. 6 are more satisfactory if stained in Delafield's hæmatoxylin. Stages like that shown in Fig. 7 and also those between Fig. 7 and Fig. 8 are the most difficult to stain, and only the utmost care and patience will insure first-class preparations. The thread on the nucleus in Fig. 7 shows a row of chromatin granules; these granules soon divide and the entire spirem ribbon splits longitudinally and then becomes segmented into twelve chromosomes, each consisting of two parallel pieces. It is said that each of these two parallel pieces of the chromosome soon shows a double row of granules, thus making the chromosome quadruple in its nature. The writer's preparations indicate that the second fission of the granules occurs. If the stain is too dense, the thread will probably appear smooth throughout all these stages, but if the staining is successful, the granules are sharply stained by the gentian violet while the linin thread is stained lightly or not at all. In successful staining with cyanin and erythrosin the granules stain blue and the linin red. Stages like Figs. 8 and 9 are easily stained, and the preparations are exceptionally beautiful. Stain for twenty-four hours in safranin (the solution in fifty per cent. alcohol is very good) and then rinse in fifty per cent. alcohol until the red color disappears from the spindle, but remains bright in the chromosomes and nucleoli; stain in gentian violet four to eight minutes; rinse in water about thirty seconds; stain in aqueous orange G fifteen to thirty seconds; transfer to absolute alcohol and move the slide gently back and forth in order to dehydrate as rapidly as possible (three to six seconds will usually be long enough); the slide must be taken from the absolute alcohol while the gentian violet is still coming out in streams; treat with clove oil ten to thirty seconds and then drain off the clove oil and add a few drops of cedar oil, since the gentian violet fades if clove oil is left in the preparation. Mount in balsam. Before transferring to absolute alcohol, a

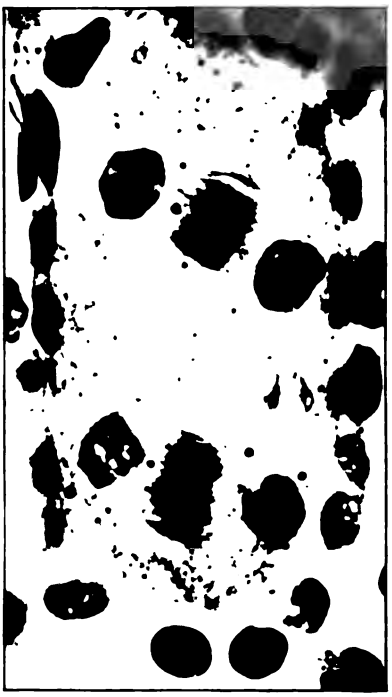


Fig. 11. Lilium philadelphicum. × 710.

Later stage in the development of the embryo-sac. Each of the two nuclei shown in Fig. 10 has divided. The nuclei are much smaller than those in Fig. 10. Fixed in chromo-acetic acid, and stained in safranin-gentian violet-orange. Fifteen microns thick.

single dip in ninety-five per cent. alcohol may do no damage and is a matter of economy, since it avoids carrying so much water into the absolute alcohol.

When the staining is properly done, the chromosomes will show a bright red color and the spindle a brilliant violet. If the action of the gentian violet be too prolonged or poorly extracted, the chromosomes will appear violet or reddish violet and such details as the relation of spindle fibers to chromosomes will be obscured. Stages shown in Figs. 10 and 11 may be found in the same ribbons with stages like Figs. 8 and 9, and are well differentiated by the same treatment.

Later stages up to fertilization and the first divisions of the embryo may be fixed and stained as already described, but cyanin and erythrosin gives a particularly brilliant effect, especially after Carnoy's fluid. At the stage shown in Fig. 12, the male nucleus takes the cyanin, and the oosphere nucleus the erythrosin, although at a slightly later stage they stain alike. For the later stages in the development of the embryo, Delafield's hæmatoxylin is a far better stain.

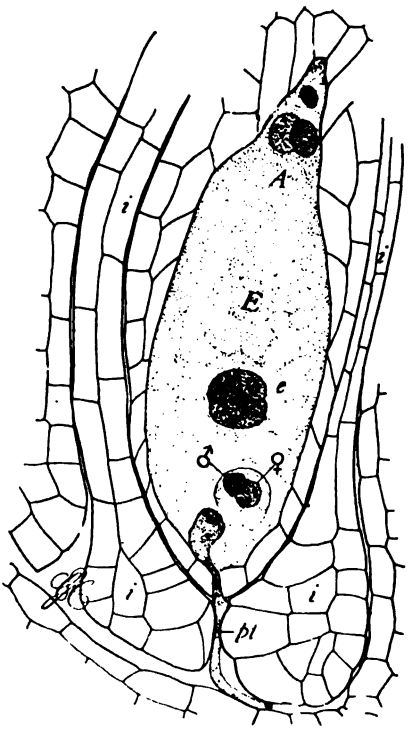


Fig. 12. Lilium philadelphicum. ×335.
Embryo-sac at time of fertilization. A. The three antipodals. E. Protoplasm of the sac. *e*. Polar nuclei fusing to form the endosperm nucleus: the male nucleus is about to fuse with the nucleus of the oosphere. *i*. The inner integument. *pt*. The pollen tube. Fixed in Carnoy's fluid and stained in cyanin and erythrosin. Fifteen microns thick.

Many of the Compositæ, like *Aster*, *Taraxacum* and *Senecio*, are excellent for a study of the mature sac and the formation of the embryo. Stages like those shown in Figs. 6 to 11 are rather unsatisfactory in Composites.

Many of the Ranunculaceæ are easily studied. *Anemone patens*, var. Nuttalliana has a very beautiful embryo-sac, the egg, synergids, endosperm nucleus, and antipodals being rather large and sharply defined. *Hepatica*, *Caltha*, and some species of *Ranunculus* are exceptionally good.

Development of the Embryo.—The common Shepherd's Purse (*Capsella bursa-pastoris*) is a favorable form for a study of the development of the embryo. The stages shown in Fig. 13 A—F will be found in pods, which are about one-eighth of an inch long. These may be put directly into the fixing agent, but stages like G and H are found in pods about three-sixteenths of an inch long and such stages will be more readily fixed, infiltrated, and cut if the pods are trimmed, as shown in Fig. 4 B, before putting them into the fixing agent. Cut sections parallel to the flat face of the pod. Delafield's hæmatoxylin, without any contrast stain, gives the best results which we have secured.

For tracing the development of a monocotyl embryo, *Sagittaria variabilis* can be recommended. Material is abundant, sections are easily cut, and it is not difficult to get a complete series. *Alisma plantago*, which is commonly figured in text-books, is extremely hard to cut, especially in later stages.

Leaves.—Where only a rapid examination is to be made, free hand sections may be made in great numbers by using the method employed for pine needles. It is easy to get good sections of leaves which can be gotten into paraffin, but it is difficult to get tender, succulent leaves into paraffin without distortion. Such

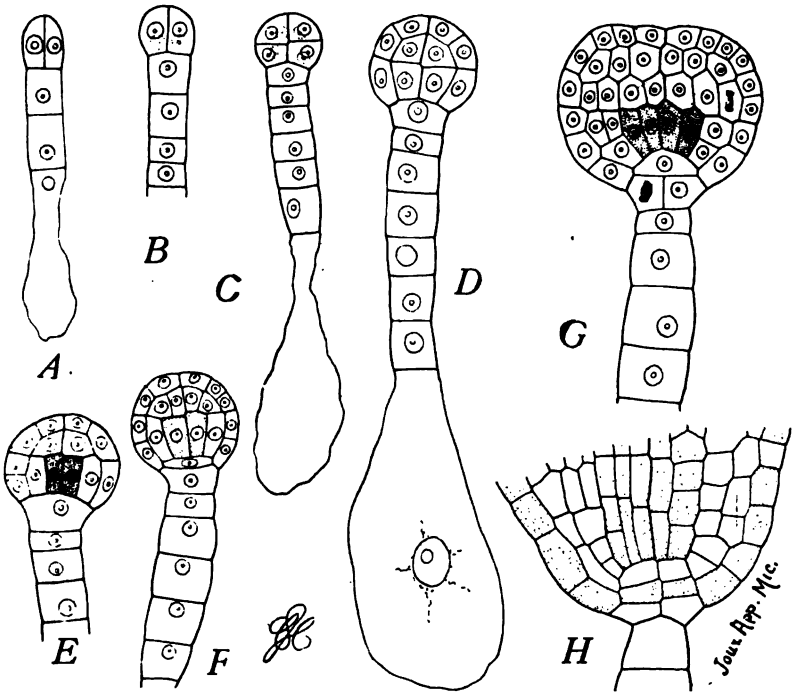


Fig. 13. Capsella bursa-pastoris. ×400.
A. First division in the embryo cell. B. Quadrants. C. Octants. D. The dermatogen has been cut off. There are eight cells in the suspensor, the lower cell being very large and vesicular. E. Differentiation in plerome and periblem. The plerome cells are shaded. F. The periblem of the root is completed at the expense of the upper cell of the suspensor. G. The mitotic figure in the suspensor cell indicates that the upper suspensor cell by a second contribution is about to complete the dermatogen of the root. H. Plerome (shaded), periblem, dermatogen (shaded), and first layer of the root cap. Fixed in chromo-acetic acid and stained in Delafield's hæmatoxylin. Ten microns thick.

leaves may be cut in celloidin. For a study of the stomata, strip a piece of epidermis from the leaf, fix it, stain in Delafield's hæmatoxylin and erythrosin, pass it gradually through the alcohols, clear in xylol, and mount in balsam. Lily, tulip, hyacinth, and begonia may be suggested as favorable forms. Epidermis from the leaf of the common *Sedum purpurascens* will usually show stomata in all stages of development.

Stems and Roots.—The earlier stages in the development of vascular bundles in stems and roots are well shown in paraffin sections of young seedlings. The common bean is a favorable form, and it is easy to get material.

Most herbaceous stems and roots and also the younger woody stems and

roots give the best results when cut in celloidin, as already described for *Pinus*. *Rumex crispus* and *Ranunculus repens* can be recommended for a study of the vascular bundles. The cambium in *Rumex* is very sharply brought out by Delafield's hæmatoxylin. Petioles or leaf blades of *Nuhar* embedded in celloidin, and stained in safranin and Delafield's hæmatoxylin yield extremely beautiful preparations, the sclerotic cells taking a brilliant red and the cellulose a rich purple. The sections should be 20–30μ thick.

Stems or petioles of the squash or pumpkin are to be preferred for demonstrating sieve tubes and companion cells. For the more minute details of the sieve plate it is best to cut out small pieces about one-fourth of an inch long and one-eighth of an inch square containing the vascular bundle. These pieces can be embedded in paraffin.

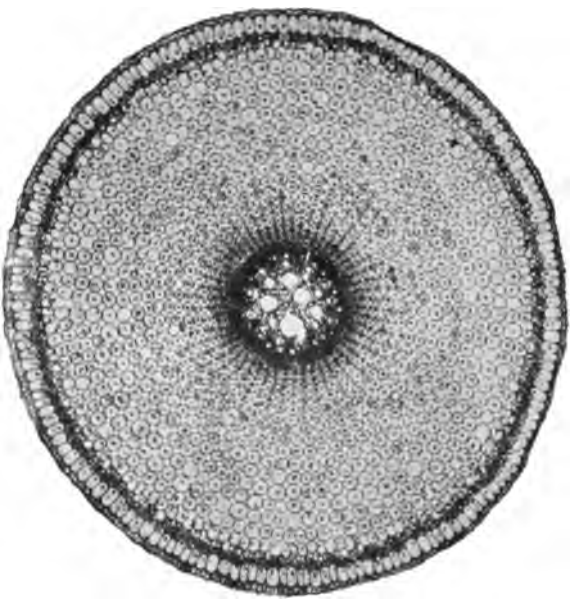


Fig. 14. Sparganium eurycarpum. · 53.
Tranverse section of a root. Delafield's hæmatoxylin and acid fuchsin. Five microns.

The stem of Indian corn, embedded in celloidin and stained in safranin and Delafield's hæmatoxylin, affords a good study of monocotyl stem anatomy.

It must not be forgotten that root tips, besides showing anatomical structure, furnish ever ready material for the study of karyokinesis. An onion thrown into a pan of water will soon send out numerous roots. About one-fourth of an inch should be cut off from the tip of the root. Fix and stain as directed for the mitotic figures in *Lilium*. While the onion is very available material, the figures are not as satisfactory as those to be obtained in the root tips of *Tradescantia virginica*, *Iris versicolor*, *Podyphyllum peltatum*, *Arisæma tryphyllum*, *Cypripedium pubescens*, and many others. Transverse sections of young roots aften show a remarkably regular arrangement of the cells, as can be seen in Fig. 14.

We are painfully aware that the directions which have been given in this series of articles are very incomplete, but it is hoped that they will enable the student to devise for himself such methods as particular cases may demand.

Finis.

LABORATORY PHOTOGRAPHY.

Devoted to methods and apparatus for converting an object into an illustration.

THE NATURALIST'S CAMERA AND KIT SHOULD BE VERY COMPLETE.

The naturalist's camera and kit and photographic outfit in general should in all justice be complete and of the best make. Not simply because of its relation to his immediate work, or lecture room and its students, but more especially because of its educational value and relation to the great masses, who now-a-days find everything in text-books, magazines, and even newspapers illustrated with photographic nicety. There is great educational value in all this. Good pictures are next in instructiveness to objects themselves, and it is said of them that if good they are eternal and everlasting, while texts and descriptions are perishable, and out of date often before they are penned and while yet buried in the inner consciousness of the writer.

The departments in our educational institutions should be provided with the best photographic and microphotographic apparatus and accessories at the outset. Then from the beginning the results will be of consequence. Touching this point we must cite a case or two from that famous region, the Bad Lands of Nebraska and South Dakota. Here the action of running water has been unrestrained and the consequent erosion is remarkable enough to attract anyone, if the Bad Lands were not so inaccessible. There are erosion figures there of every conceivable design,—toadstool parks as fantastic and interesting as those in the Garden of the Gods, Hoodoos as wierd as those in the Hoodoo Region in the National Park. There are Hen and Chickens and Punch and Judies and Mother Grundies in great profusion, surrounding the mighty castles, hills, buttes and mountains of clay.

Perhaps the consideration of such geological features is not strictly consonant with the demands of a microscopic journal, in which photographic notes are presumably to be photomicrographic. However, naturalists are interested in macroscopic as well as microscopic study, and the former naturally precedes the latter, and we may find therein a justification for spending a moment on the gross anatomy of an erosion figure or two from the Bad Lands. Later we shall endeavor to meet the more exact demands of this journal by offering something on the minute anatomy of the same subject by sectioning and preparing photomicrographs of some of its fossils. The Bad Lands look just like a great artifical relief map modelled in clay, and the naturalist finds in every corner of it lessons and interesting suggestions. But how can these living lessons and examples be taken to the laboratory and class room, seeing that we cannot take the class there? By the camera of course, or possibly by the ancient and honorable but less accurate method—the brush and pencil.

For students' use good pictures are all but equal to the actual objects. These may be in the form of prints, enlargements, positives for the projecting lantern, half-tones for magazines or books, or transparencies for the laboratory window, where their lessons must shine into the student's mind every time he enters.

Fig. 1.—Highly developed erosion in Miocene clay, showing ribbon-like stratification. The very backbone of the Big Bad Lands. Portion of a great amphitheatre near the entrance of Lone Tree canyon, Sheep Mountain, South Dakota. Taken at 6:30 P. M. with a Bausch & Lomb 6½ x 8½ telephoto lens, and Bausch & Lomb Anastigmat, Series III-A. Distance two miles.

This view, which was particularly desired for a special purpose, could be taken from but one position and at but one time of day, and by the telephoto lens only. Otherwise the view was a flat failure, as shown in Figs. 2 and 3, and of no use in illustrating the point under consideration. Without the telephoto lens our plans would have been defeated, hence the importance of being equipped. Plans and purposes once or twice defeated equal in loss the cost of such a lens. Taken on the Morrill Geological Expedition of 1897, by Mr. U. G. Cornell, The University of Nebraska.

Fig. 2.—Highly eroded bad lands, looking toward Sheep Mountain, Big Bad Lands, South Dakota.

The erosion figures shown in Fig. 1—the subject desired—may be seen in the distance along the line A. However, it is but faintly shown at the best, even though taken with the best of lenses and at the most favorable time of day. Hills of clay 200 to 400 feet high rose in increasing numbers as we climbed laboriously toward the objective point. Our telephoto lens looked directly over the heads of these same hills and brought the distant object to us, instead of us going to it, and with better results, as in Fig. 1. Taken with a Zeiss Anastigmat, Series III-A. Morrill Geological Expedition, 1897. Photographed by Mr. U. G. Cornell, The University of Nebraska, Lincoln.

Fig. 3.—The same bad lands as shown in Fig. 2, taken at a less favorable time of day, that is, after nine o'clock, when the light was so reflected and diffused that shadows were obliterated.

Here the objective point (along the line A) was still less distinct than in Fig. 2. Either Fig. 2 or 3 would convey a meagre if not a false idea of this phase of erosion in the bad lands, while Fig. 1, taken as it was with proper apparatus, gives an idea correct to the last degree. This view shows miles of unbroken bad lands. Taken with a Bausch & Lomb-Zeiss Anastigmat, Series III-A. Morrill Geological Expedition, 1897. Photograph by Mr. U. G. Cornell, The University of Nebraska.

We have chosen our illustrations from among some four hundred views to emphasize the idea that the photographic kit of any scientist ought to be as complete as possible. If not possible, make it complete anyway.

Perhaps the views offered may not be artistic compositions. That is not the chief consideration. If they are fairly representative of a given condition, that is the main point. If space and time would permit, it would be a gratification to offer something a little less inartistic, and to show the erosion figures characteristic of the Titanotherium, the Metamynodon, the Oreodon and Protoceras layers, all of which belongs properly to the domain of the geological journals. We will confine our attention to the erosion figures chiefly in the Oreodon beds, of which

Fig. 4.—Chapeaux des Femmes, Big Bad Lands, South Dakota. Mountain of Miocene clay (Oreodon Beds), 400 to 500 feet high, with pinnacles of Protoceras sand, viewed from the west.

This proved to be inaccessible from the west, but on the second day we succeeded in ascending the summit from the east slope. The stratification here was bright enough to remind one of a Roman sash. Taken with a Bausch & Lomb-Zeiss Anastigmat, Series III-A. Morrill Geological Expedition, 1897. Photograph by Mr. U. G. Cornell, The University of Nebraska, Lincoln.

Fig. 5.—Protoceras pinnacles summit of Chapeaux des Femmes, Big Bad Lands, South Dakota, showing hardened layers, cross-bedding, and the erosive action of wind and water.

These were reached on the second day. Our telephoto lens, had it been at hand on this occasion, would have reduced the work of three men and a team from two days to two minutes, and would have done the work better, for it would have shown all of the pinnacles, and would have paid for itself in the bargain. The absence of clouds and atmosphere is due chiefly to the clear, dry, and cloudless air. However, this defect would not be so glaring had we used our ray filter, as we usually do. Morrill Geological Expedition, 1897. Photograph by Mr. U. G. Cornell, The University of Nebraska.

there are unbroken miles reaching forward, backward, and all around as far as one can see. It is bare, sun-dried, cracked, crumbling Bad Lands. Not bad in the sense of sterile, but bad to traverse—"*Mauvaises Terres a traverser.*" Indeed, they are good lands, but so situated that they wash excessively and plants cannot get a footing. There is no better spot for the study of the action of running water. It is a great out-door laboratory devoted to physiography, where the student absorbs more information by mere contact, on a single visit, than could be acquired by the labored perusal of descriptions. They are magnificently gullied and gashed in a general way, and in detail are sculptured and carved to

the last degree. Altogether they are desirable scenes, but several things militate against their perpetuation by the camera. The altitude is high, about 3500, the air is dry and clear, and the light so actinic, and the clays and sands so light in color that it is equivalent to photographing white light itself to expose a plate to sunshine reflected from these glaring hillsides. Accordingly most of our views were made early in the morning, before 9 o'clock, often before 8, and late in the afternoon, generally after 6 o'clock. At such times there were shadows, at other times in the day when the sun was higher the shadows, even in the deep recesses, were obliterated by the reflection and diffusion of light, and views were flat, characterless, and useless.

Another difficulty confronted us in the great number of pinnacles and hills, which, as we advanced, arose in the foreground to cut off the view, and to add distracting details to the ruination of the very example which at a distance of two miles seemed so desirable.

Notice here the limitations which are imposed upon the man whose camera is not supplied with suitable lenses and other accessories ready for instant use. The wide angle lens is indispensable for a certain view, the narrow angle for another, the Telephoto for the next, and the ray filter for others. Without these he must invariably substitute inferior views for the superior ones which so appealed to him. Inferior negatives mean inferior prints, inferior positives for class work, inferior engravings. Thus some of the best plans and intentions are defeated.

Figure 1, as viewed at 6 o'clock in the evening from a given prominence, at a distance of two miles, seemed an admirable example of one type of Bad Lands erosion. For our purpose it could be taken at but one time of day, and from one point of view. Go closer and the summits of countless intervening forms arise, cut off the view and detract from the desired feature, as may be seen in Figure 2, further discussion of which is unnecessary when the photograph is here to talk for itself. When taken at another time of day, the effect is even less satisfactory, as Figure 3 will show. But the time and the place limit, means less to the camera which is provided with a Telephoto lens, which can be instantly affixed and the picture taken at the first impulse when the view is just to our liking.

Without this invaluable aid, we would have walked two miles over the most rugged, steep, and inaccessible Bad Lands only to find the coveted view fading and eluding us as we approached it. In a general view it is often very desirable to get detached views to show details of structure, texture, etc. This is rendered possible by the Telephoto lens without stepping out of one's tracks. In Figure 4, the mountain proper consisted of beautifully banded clays known as the Oreodon beds capped above by a sandy layer known as the Protoceras beds.

Each bed had its peculiar type of erosion and it was desirable to ascend the Chapeaux des Femmes, to see just what style of hats they were. The first day the summit from the west proved to be inaccessible. On the second day we reached the summit, and by means of a wide angle lens were able to get two out of the many lofty figures which stood there. See Figure 5. This one view cost the writer and an assistant, besides a guide and team, two days. Had our Telephoto lens been at hand on that occasion the work of two days could have been done,

and done better, in two minutes. On this one occasion then the Telephoto lens would have probably paid for itself, and the desired end could have been attained without loss of time or waste of energy. It pays to be well equipped. Get a good camera and the best of lenses at the start. It costs no more in the end and the results in the meantime amount to something.

The University of Nebraska, January 15, 1900. ERWIN HINCKLEY BARBOUR.

PRACTICABLE PHOTOMICROGRAPHY.

II.

OBJECTIVES AND CONDENSERS.—Scientific research in optics, improvement in optical glass, with gradual elimination of errors sometimes seemingly trivial to the ordinary laboratory worker, have made possible the present advances in photomicography during these more recent years, until we who are reaping the benefit of these improvements can photograph the most difficult objects with comparative ease, our obstacles being mainly those of technique in cutting and staining tissues.

Some manufacturers who have been unwilling to sacrifice some pet theory are still working to prove these theories in spite of laws now well known and obeyed by those who have reaped that certain reward of obedience to law which is called by some "success"—by many, too often, "chance."

Those whose names to-day are recognized as worthy of honor and gratitude have worked almost unrewarded in many cases, and in the face of violent opposition.

Whether the front system of an objective consist of crown or flint glass, or be single or double, means comparatively little to the worker with an ordinary microscope; but these things mean everything to the photographer of microscopic objects who needs all possible aperture suitable to the power used and all possible correction of spherical and chromatic aberration.

What wonders have been accomplished since Leuwenhoek, in 1672, published his observations of bacteria with a simple lens, a glance into any of our laboratories will show, but only partially, until some veteran worker proudly exhibits to you his favorite lenses, expatiating now on the lighting of the field, now the exquisite definition, keeping you till the wee small hours, until after breathless manipulation of light and collar correction he triumphantly shows the striations on *Amphipleura pelucida*, or the 19th band of Nobert's plate.

The writer well remembers his first lessons as a boy back in the sixties, looking with awe and interest through the microscope owned by one of the pioneer physicians and scientists of the Western Reserve, the stand of the queer model of those days, a still queerer French triplet lens with dividing fronts of varying powers from one inch to one-quarter inch.

There were strange iridescent rings around the outside of the field and "dishing" of the object, which we now condemn as chromatic and spherical aberration.

The microscope and objective were made by a famous French optician, but our ordinary student microscopes of to-day far surpass them.

mm. of 0.65 N. A. and the 2 mm. oil immersion apochromats, and the others perfectly corrected achromatic.

With such objectives and a good camera the best of work can be done by earnest workers.

The writer is well aware of the magnificent work done by the late Surgeon-General Woodward with Tolles and other achromatic objectives, having some of his photographs in our collection and having more than once handled with reverent care the splendid collection of lenses at the Army and Navy Medical Museum, including a $\frac{1}{8}$ inch by Tolles, probably the first homogeneous immersion objective made.

But we are not all Woodwards, nor have we such facilities as he had, and he would have surpassed himself if he had worked with some of our present objectives.

We have in our own collection five of the best immersion lenses made, including a $\frac{1}{6}$ and $\frac{1}{15}$ of 1.35 N. A., and $\frac{1}{8}$ and $\frac{1}{12}$ apochromatic of 1.40 N. A., and a $\frac{1}{10}$ of 1.43 N. A.; also a full set of Zeiss apochromatic dry objectives, viz., 24, 12, 6 and 3 mm. of highest possible N. A; but we use two of these 99 times in 100—the Zeiss 12 mm. dry apochromatic of 0.65 N. A. and the Powell and Lealand $\frac{1}{8}$ inch immersion apochromatic of 1.40 N. A.

The 12 mm. Zeiss apochromatic of 0.65 N. A. is our most useful dry lens, being capable, with proper illumination, of almost any amount of magnification without breaking down, and gives a far better negative with No. 3 projection ocular at 1000 mm. camera extension than any achromatic $\frac{1}{8}$ or $\frac{1}{6}$ at the same magnification.

Any one can satisfy himself of this by making two negatives at 300 diameters with full cone of light, using this objective and any $\frac{1}{6}$ of any good maker, and the apochromat will reveal details of structure that are impossible to the less well corrected objective.

In regard to condensers our readers will remember that many objectives can be used as condensers—we have just been making some negatives of *P. angulatum* with 6 mm. apochromatic of 0.95 N. A., using the objective above named as a condenser.

We need also to sound a note of warning in regard to the other optical parts of the apparatus, lest some errors should creep in and offset the advantages of fine objectives and condenser.

The large collecting lenses on our optical bench, with cooling cell and ray filtering trough, should all be of best construction and glass, as also an achromatic lens for rendering the rays parallel before they enter the substage condenser.

This last mentioned is of great value—almost a necessity for equally lighted fields.

With these conditions realized in all parts of our optical apparatus we shall need only special methods of technique and experience—of the former we may write later—the latter comes with time, oft with failure, but ultimately crowned with success.

CHARLES H. POTTER, M. D.

Baltimore Medical College.

Journal of
Applied Microscopy.

L. B. ELLIOTT, EDITOR.

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The majority of our subscribers dislike to have their files broken in case they fail to remit at the expiration of their paid subscription. We therefore assume that no interruption in the series is desired, unless notice to discontinue is sent.

WE learn with deepest regret of the death on February 17th of Mr. Herbert R. Spencer, son of Charles A. Spencer, the pioneer objective maker of America, in the fiftieth year of his age. Having the advantage of experience and training under his father's guidance, and especial aptitude and love for his chosen work, his loss to applied optics cannot be estimated. The close of his life is the final chapter in the work of America's three eminent pioneer co-laborers in the improvement of the microscope: Charles A. Spencer, Robert Tolles, and Herbert Spencer.

DR. GEORGE E. BLACKHAM, one of Mr. Spencer's long-time friends, has kindly given us the following information regarding his life:

Born November 1, 1849. Got a fair common school education; entered his father's optical shop in Canastota, N. Y., while still quite young, exact date not known. Was one of six children, of whom one brother, Charles P. of Geneva, N. Y., and two sisters, Mrs. O. T. May of Geneva, and Miss Ida E. Spencer of New York City, survive him, as does his mother, now eighty-three years of age.

After the destruction by fire of their shop, with most of its tools, drawings, and records, and much finished and partly finished work, the Spencers gathered up the fragments and started anew in an old barn in Canastota; but in 1875 moved to Geneva, N. Y., where for a couple of years they were connected with the Geneva Optical works, then resumed business on their own account under the firm name of Charles A. Spencer & Sons. This arrangement continued for three years, during which time they received from the Paris Exposition the highest award—the grand gold medal—for excellence of their objectives for the microscope, and this in spite of the fact that they had not, themselves, entered any of their work for competition, the award being given to certain objectives of their make entered by President Barnard of Columbia College, N. Y., a U. S. Commissioner to the Exposition.

In 1880 Herbert began business under his own name in Geneva, continuing there till 1889, when he went to Cleveland, O., where he established the H. R. Spencer Optical Company. In 1881 he moved to Buffalo, N. Y., where, in company with Mr. Fred. R. Smith, another skillful pupil of Charles A. Spencer, he began work under the name of the Spencer & Smith Optical Company. In 1895 they separated, and Mr. Spencer became superintendent of the Spencer Lens Company of Buffalo, N. Y., continuing to the time of his death, February 7, 1900.

The funeral services were held at his late residence, 566 West avenue, Buffalo, February 9, 1900, and his remains incinerated at the Buffalo Crematory and the ashes buried in Geneva.

He was always a most skillful workman, making objectives which, to say the very least, were always at least equal to the best made elsewhere at the time. His Aplanatic eyepieces were, in my opinion, a distinct advance, giving better results both for visual work and especially for photomicrography, than any other eyepieces with which I am acquainted. His short-focus telescopes were remarkable for their great power, wide field, and exquisite definition, and his high-grade objectives were always in the very front rank.

Personally, he was of a modest and reserved temperament, not easy to get acquainted with, but most genial and cordial to his intimate friends. A severe critic of his own work, I never heard him say a word in disparagement of the work of others.

His death at the early age of fifty years seems to me an irreparable loss to microscopy.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to Charles J. Chamberlain, University of Chicago, Chicago, Ill.

REVIEWS.

Lotsy, J. Contributions to the Life History of the Genus Gnetum. Ann. du Jardin Bot. de Breitenzorg. Second Ser. I: 46–114, pl. 2–11, 1899.

Our knowledge of the life history of the Gnetaceæ is based upon comparatively few observations because it has been so difficult to procure material, one genus, *Welwitschia*, being found only in Damara-land, Africa, another genus, *Ephedra*, being a desert plant, and the remaining genus, *Gnetum*, being confined to the tropics. Moreover, as in case of most gymnosperms, the collecting must extend over a considerable period in order to insure anything like a complete series of stages.

Dr. Lotsy's somewhat extended stay at the Breitenzorg Botanical Gardens in Java enabled him to secure a very complete series of stages in the development of *Gnetum gnemon* from the earliest appearance of the flowers up to the formation of the embryo.

The inflorecences of *Gnetum gnemon* are spikes which come from the axils of opposite bracts. On each spike is a series of cups which owe their origin to a concrescence of bracts. At the base of each cup is a ring of tissue upon the upper part of which may be seen a number of small, cone-shaped, greenish bodies; these are the female flowers. The mature female flower has three envelopes which are formed in acropetal succession. The rudimentary female flowers, which are found on the staminate spikes, have only two envelopes. The author regards the two outer envelopes as whorls or bracts which, for convenience, may be called the internal and external perianths; the inner envelope, which is longer and projects above the other two, he regards as an integument. At the period of pollination a drop of fluid appears at the top of the integument, and consequently the term, integumental stigma, is applied. Pollination is probably effected by the wind, though it may be that insects have some part in it. There is a pollen chamber at the top of the nucellus formed by the degeneration of cells in that region. Before reaching the embryo-sac, the pollen tube contains a tube nucleus and two generative nuclei. The details of spermatogenesis are reserved for a future paper.

Each nucellus contains several macrospores which originate as in well known Gymnosperms. The early divisions in the macrospore do not seem to differ from those in *Pinus* or other familiar forms, there being first a series of nuclear divisions so that a large number of nuclei lie free in the protoplasmic lining of the embryo-sac. The history from this stage differs from that of other Gymnosperms. A constriction appears somewhat below the middle of the sac, reducing the lumen at this point, but by no means separating the upper and lower portions. Walls now appear in the lower portion so that it becomes filled with solid tis-

sue. In the upper portion the nuclei remain free in the protoplasmic lining of the sac.

At this stage, one or more pollen tubes enter, each bringing in two generative nuclei. Each generative nucleus fuses with one of the free nuclei in the sac and the several copulation products, which become surrounded by denser protoplasm and soon acquire a membrane. They are now called zygotes. The zygotes germinate into long tubes which grow down toward the base of the sac and penetrate the solid tissue there. During this time this solid tissue has been increasing enormously and in the mature seed the fertile portion of the sac appears as a mere speck at the apex of this prothallial tissue. At this stage the seed falls from the plant.

The development of the embryo from the tube which arises from the zygote has already been described by Bower.

The author suggests the following homology with the structures of the angiosperm sac.

ANGIOSPERMS.	MORPHOLOGICAL NATURE.	GNETUM GNEMON.
Egg apparatus	=Archegonia	=Fertile nuclei.
Micropylar polar nucleus	=Prothallium	=Sterile nuclei of upper part of sac.
Chalazal polar nucleus	=Prothallium	=Prothallium in lower part of sac.
Antipodals	=Rudimentary archegonia	=Rudimentary archegonia on lower part of sac.
Endosperm	=Prothallium	=Growing prothallium of lower part of sac.

The conclusion is reached that the Gnetaceæ are very ancient in origin and that they must have originated before or at the same time with Gymnosperms (by this probably meaning the Coniferæ). He is inclined to regard "the Gnetaceæ as the equivalent of the Gymnosperms and Angiosperms combined and running parallel to these, having originated entirely independently of them. In these two parallel rows the Gymnosperms may be compared to the Ephedroideæ and the Angiosperms to the Gnetoideæ."

There will be objections to this interpretation if current views as to the geological history of the group are well founded. C. J. C.

Coulter, John M. Plant Structures, a second book of Botany. 8vo., pp. IX+348, 289 illustrations. D. Appleton & Co., New York, 1899. $1.20.

Those who have examined Prof. Coulter's book on Plant Relations will be glad to note the appearance of the complementary volume on Plant Structures. The present volume, while called a second book of botany, presupposes no more previous knowledge of the subject than did the Plant Relations and may be used as a first book by those who believe that a knowledge of structure should precede any study of ecology.

Over two hundred pages are devoted to the story of the evolution of the plant kingdom from the lowest algæ up to the flowering plants. This is the leading feature of the book, and where time is much limited these 200 pages

would make a very acceptable course in botany for high schools and academies, presenting, as it does, the principal groups of plants with their characteristic structures and with the structures presenting enough of their functions to give them meaning. Particular emphasis is laid upon those structures which are of most value in determining the relationships of the groups.

The remaining chapters—about 100 pages—are devoted to five topics, The Flower, Monocotyledons and Dicotyledons, Differentiation of Tissues, Plant Physiology and Plant Ecology. The chapter on Monocotyledons and Dicotyledons, after giving the contrasting characters of these two divisions, presents their larger subdivisions in what is now most generally regarded as their genetic sequence. In this chapter the author has succeeded in presenting in readable form a subject which has hitherto been a dreary enumeration of tribes and cohorts, serving to discourage the student rather than to awaken a desire for more information.

The chapters on Physiology and Ecology may be regarded as a brief review of the other book, Plant Relations, or they may serve equally well as an introduction to that work.

An unusually large number of drawings and photographs were made expressly for this work. It is doubtful whether any text-book of botany for secondary schools equals this in respect to illustrations: certainly none surpasses it.

The book is not a laboratory manual, but is to be read in connection with laboratory work. In reading the chapters one cannot fail to notice the elegant style in which they are written.

A pamphlet containing suggestions to teachers and also directions for collecting, preserving, and preparing material accompanies the text-book.

C. J. C.

Vogl, A. E. Die wichtigsten vegetabilischen Nahrungs-und Genussmittel. Pp. XV+575. Figs. 271. Wien, Urban u. Schwarzenberg, 1899.

This book on economic botany has to do very largely with the morphology and histology of the plant products used as food, spices, and beverages, including also the same considerations upon the plant products used in substitution and adulteration.

This book is written primarily to assist in detecting substitutions and adulterations. In order to do this a good knowledge of the histology of structures is essential, as well as some knowledge of the chemistry of the products considered. In connection with the chapter on flour, the discussion and figures of starch grains is especially interesting. A large number of kinds of starch grains and the plants producing them are presented, and a key is given which is to be used in microscopic examinations for detecting starch from various plants.

The rather brief chapter on vegetables contains an interesting discussion of the edible fungi. The author suggests that because of the usual environment of the mushrooms, and since insects and larvæ which frequently inhabit them may secrete poisonous substances, it is yet an open question as to whether the mushrooms are desirable as food material. A good key is given for distinguishing the edible from the poisonous fungi. There is a chapter on fruits, one on narcotic "pleasure yielding" plants, and an extensive and comprehensive chapter

on spices. The closing chapter deals with the substitutes and adulterants of ground spices.

The economic product, rather than the taxonomy of the plant producing it, is emphasized. The chemistry of the products is not emphasized as much as will be desired by many readers. The figures are good, and will doubtless be of very great assistance to many who wish to compare substances under examination. The book is interesting throughout and is one of the best upon its subject.

Illinois State Normal School. OTIS W. CALDWELL.

CYTOLOGY, EMBRYOLOGY, AND MICROSCOPICAL METHODS.

AGNES M. CLAYPOLE.

Separates of papers and books on animal biology should be sent for review to
Agnes M. Claypole, Sage College,
Ithaca, N. Y.

CURRENT LITERATURE.

Eisen, G. On the Blood-plates of the Human Blood, with Notes on the Erythrocytes of Amphiuma and Necturus. Jour. of Morphol., 15: pp. 635–662, 1 pl., 1899.

The author has previously published a statement that plasmocytes exist in the human blood, and in this paper he shows that various kinds of blood plates occur. Of these kinds plasmocytes are called the true plates, and are shown to have a complicated structure. Of the methods of investigation used, the dry preparation is the only one of any value. Blood is spread on covers in the usual way, and these are pulled apart quickly. All glass must be chemically clean or else the fine filaments of the blood plates will not be extended. In wiping and polishing the surface a double thickness of linen must be used to protect the glass from the fingers. Films are air-dried for twelve hours and fixed in absolute alcohol. No other fixative gave as fine differentiation as this. Only a few stains are of any value. Films may be placed in a weak aqueous solution of toluidin for from a few minutes to several hours; a 1 per cent. solution of toluidin for twenty-four hours gave the best results. Washing in water was followed with drying by means of a vaporizer and mounting in thus-balsam. Only blood-plates and leucocytes are stained by this method. A second way is by double staining with eosin and hæmalum. Use eosin for five minutes, followed by washing with water for several minutes, or until no diffuse stain is visible in the film outside of the red cells. Counterstain with a strong undiluted hæmalum for from ten minutes to one-half hour. Wash with water, dry, and mount in thus-balsam. This method stains the filaments of the blood plates intensely red, but gives less differentiation of the inner spheres and also stains degenerating red cells and other debris. Hæmalum is the only hæmatoxylin compound that stains the inner sphere and centrosomes. Preparations were all studied with a Zeiss apochromat 3 mm. aperture 1.40, oculars 8 and 12, with an Abbe achromatic oil substage condenser. The latter is necessary to bring out the finer details. An achromatic light filter was also used to

make the light pure and steady. After giving an historical review of the discovery and theories concerning blood-plates, the author states his belief that blood-plates are neither derived from budding erythrocytes nor from leucocytes, but are archosomes (centrosomes with spheres) of erythroblasts or other nucleated cells, which archosomes have separated themselves from their attachment to the nuclei in the same way that plasmocytes of batrachian blood separate from fusiform corpuscles. The author summarizes his results as follows:

1. Distinction must be made between true and false blood plates, between organized and unorganized. The true plates are derived from plasmocytes, false plates are either from fusiform corpuscles, degenerating fragments, or leucocytes and erythrocytes, or precipitations of fibrin and globulin.

2. In the blood of Batrachoseps (a batrachian) two kinds of organized plates occur, fusiform corpuscles and plasmocytes, the latter rising from the former.

3. In human blood the plates are plasmocytes only. In these plates are: three outer cytoplasmic spheres, three inner cytoplasmic spheres, a centrally or laterally placed highly refractive granule.

4. In human blood under certain conditions false blood-plates appear. These possess none of the above characters.

5. It is proposed to call true blood-plates *plasmocytes*, not *blood-plates*.

6. In bactrachian, reptilian, and saurian blood, two distinct kinds of red corpuscles are recognized, and two kinds of fusiform corpuscles; each kind of red corpuscle degenerates into a distinct kind of fusiform corpuscle.

7. In amphiuma and necturus one class of erythrocytes is oblong, another rounded having distinct characteristics.

8. The two kinds of fusiform corpuscles have the same general characters, and arise from erythrocytes through degeneration.

9. The functions of globules and granules in oblong erythrocytes are probably mechanical.

A. M. C.

Calkins, G. N. Mitosis in *Noctiluca miliaris* and its Bearings on the Nuclear Relations of Protozoa and Metazoa. Jour. of Morph., **15**: 711–772, pl. 3, 1899.

Material for the work was collected at Beaufort, N. C., and Port Townsend, Puget Sound, and was killed in corrosive sublimate (sat. norm. salt), sublimate-acetic (10 per cent. acetic), picro-acetic (Boveri's formula with 1 per cent. acetic for Beaufort material, saturated picric with 5 per cent. acetic for that from Puget Sound), Hermann's fluid and Flemming's stronger solution. The fixed material was either mounted in toto or embedded in paraffin and sectioned. Difficulty in handling such minute objects was overcome by putting alcohol containing noctiluca in a glass cylinder two inches long and half an inch in diameter, and covering the end with very fine bolting cloth. Carrying this tube from one liquid to another was an easy process. Heidenhain's iron hæmatoxylin, Biondi-Erlich, and Reinke's modification of the Flemming triple method gave the best results in staining. Bordeau red, orange and eosin were used as secondary stains with iron hæmatoxylin.

The author's results are summarized as follows: 1. The resting nuclei of *Noctiluca miliaris* are large, round, or oval structures containing chromatin in the form of karyosomes, and achromatin in the form of large granules. It is

enclosed by a nuclear membrane which persists in part throughout nuclear division. 2. The cytoplasmic substance corresponding to the centrosphere of many metazoan cells is invariably present. It is a permanent organ of the cell, often as large or larger than the nucleus; it divides to form an amphiaster, consisting of two asters with connecting mantle fibers, the central-spindle. 3. During the division of the sphere the nucleus elongates and bends to form a figure like the letter C. The central spindle sinks into the opening thus formed and is finally almost enclosed by the nucleus. 4. As division progresses, the central-spindle becomes three or four times as long as it is in the metaphase. 5. The karyosomes break up into many chromatic elements, and form in some cases beaded fibers, which are the only indications of a spireme stage. Chromosomes then arise from the granules. 6. The chromosomes thicken at first next to the central spindle, and later throughout. 7. The chromosomes divide longitudinally while lying in the nuclear plate, the halves then separate beginning at the proximal ends. 8. While chromosomes form, the nuclear membrane disappears from between them and the central spindle, leaving them in contact with the spindle fibers. 9. The central-spindle fibers do not connect with the chromosomes, but pass from pole to pole. The mantle fibers connect the chromosomes, passing from the centrosomes in the spheres to the ends of the chromosomes. 10. The nucleus, during the anaphase, elongates in the direction of the central spindle. The chromosomes are pulled apart and form daughter chromosomes thickened at the proximal ends. 11. The nucleus divides in the center, the furrow is obliterated and the nuclear membrane is reformed. 12. In spore forming divisions, the nuclei do not return to the resting state. The daughter spheres divide and form secondary, etc., amphiasters and the daughter chromosomes form the nuclear plate of the next division without change, and split longitudinally. This process is repeated eight or nine times. 13. A centrosome is always found in the sphere during metaphase and anaphase stages as the focal point of mantle fibers, but is absent during resting stages. It divides in the early anaphase in anticipation of the next mitosis. 14. The centrosome comes possibly from the nucleus in which a small deeply staining granule appears during the resting stage. This granule disappears during chromosome formation. Two distinct granules are often seen in a space formed by the rupture of the nuclear membrane. The inference is that the centrosome is a permanent organ found in the nucleus, but becoming extra nuclear by the rupture of the nuclear membrane. This is not, however, proved. A. M. C.

Garrey, W. E. The Effect of Ions upon the Aggregation of Flagellated Infusoria. Am. Journ. of Physiol. 3: 291–315, 8 figs., 1900.

The investigation was carried on under the oversight of Dr. Loeb, and was started with a view to determining whether there exists in the Flagellata an orientation to lines of diffusion of chemical ions, whether chemotropism exists, also chemokinesis. The form used is the Chilomonas obtained from peat moss from the Lake Superior region; it is a pear shaped organism with two long flagella and a contractile vacuole. It is invisible to the naked eye. A hard rubber chamber was used about 1 or 1½ mm. deep, made by fastening hard rubber to a slide with sealing wax. An opening 1½ m. wide is left on one side of the border of the chamber, the opening

is covered by a piece of cover-glass countersunk flush with the surface. The tube thus formed, called the "diffusion tube," can be filled by capillarity with the fluid to be tested. A cover-glass is pushed over the chamber from the side opposite the tube and the chamber filled with the culture as fast as covered. The culture and the solution come into contact as soon as covering is completed and diffusion begins. The author gives the following summary of his results: 1. There exists a complete analogy between the effect of chemicals upon the reactions of the flagellated infusorian chilomonas and the effects of other stimuli (light, etc.). Two causes can be distinguished for such gatherings of organisms, first, chemokinesis, and second, positive chemotropism. 2. In determining the effect of ions upon the reactions of organisms, equal percentage solutions must not be compared, but only solutions having the same ion concentration. 3. Toward the alkalies LiOH, NaOH, KOH, $Ca(OH)_2$, $Sr(OH)_2$, $Ba(OH)_2$, chilomonas shows chemokinesis due to the effect of OH-ions, chemically equivalent solutions of these alkalies contain the same number of OH-ions per unit volume and produce equal effects. 5. Toward inorganic acids HCl, HNO_3, H_2SO_4, chemokinesis is shown to be caused by the H-ions. H-ions have a more powerful effect on chilomonas than OH-ions. 5. The effect of the carbonates of the "alkali metals" and "alkali earths" is qualitatively similar to that of the alkalies and probably due to OH-ions, but possibly in part to CO_3-ions. 6. NH_4OH only incompletely dissociated gives as marked an effect as other alkalies. 7. The effects of CO_2 on chilomonas are the same as of H_2CO_3, and agree with other weak inorganic acids. 8. A series of inorganic salts of Fe, Zn, Cu, Hg, and Ag produced a chemokinetic effect due to the cations, sufficiently weak solutions give no H-ions. 9. Organic acids produce chemokinesis, but are not effective according to direct ion-concentration. Acetic acid has a more marked effect than it should according to the above law. As suggested by Loeb and Ostwald, this may be due to the transformation of organic acids into other substances within the body of the animal. 10. The use of very dilute solutions of certain organic acids, for example acetic, lactic, butyric, produces different effects from those already considered. Chilomonas is positively chemotropic to these solutions. The effect is due to the action of anions or undissociated molecules. A. M. C.

RECENT LITERATURE.

Arnold, J. W. Flemming und die Mitomlehre. Anat. Anz., **16**: 607–615, 1899.

Hertwig, O. Ueber die Stellung der Anatomie und Physiologie in den medicinischen Prüfung. Anat. Anz., **16**: 594–600, 1900. ("Keine überflussige Prüfung am wenigsten aber eine Prüfung: 'Zwei mal dasselbe,' in der medicinischen Vor und Schlussprüfung.")

Bordage, E. Sur le mode de croissance en spirale des appendices en voie de régénération chez les Arthropodes. Compt. Rend. Acad. Paris, T. 129, **10**: 455–457, 1899.

Bordage, E. Sur un mode particulier des appendices en voie de régénération après sections artificielles chez les Insects. Compt. Rend. Acad. Paris, T. 129, **13**: 501–504, 1899.

Schwartze, Erich. Zur Kentniss der Darmentwicklung bei Lepidopteren. 4 Taf. Zeitschr. f. wiss. Zool., **66**: 450–496, 1899.

Oppel, A. Ueber die Zunge der Monotremen einiger Marsupialier und von Manis javanica. 5 Taf. Zoöl. Forschungsreisen in Australien und den Malayischen Archip. ausgef. V. R. Semon, Leip., **15**: 4, 1899.

NORMAL AND PATHOLOGICAL HISTOLOGY.

RICHARD M. PEARCE, M. D.

Harvard Medical School, Boston, Mass., to whom all books and papers on these subjects should be sent for review.

Ribbert. On the Termination of Pneumonia in Induration. Virchow's Archiv. **156**: 164, 1899.

The origin of the vascular connective tissue which fills the air spaces of the lung in organizing pneumonia has been the subject of much discussion.

The oldest and probably most commonly accepted theory is that it arises from the alveolar wall. A second theory is that it arises from the subpleural and interlobular tissue, and a third that it arises from the bronchi and bronchioles.

Ribbert opposes the first theory and shows that the organization begins as an outgrowth from the connective tissue in the wall of the smallest bronchi and the bronchioles, especially the latter, and grows into the alveoli. In the early stages the new tissue is farther advanced in the bronchioles and bronchi. Sometimes there is no connective tissue in the alveoli.

He does not deny the possibility of occasional origin in the alveolar wall, but he has never observed it. Very early cases must be studied to prove it.

In the ordinary histological preparations the connective tissue seems to originate from the alveolar wall. This, however, is not the case; the connective tissue really passes through the wall in the fine openings which in the early stages of pneumonia frequently contain threads of fibrin. Later these perforating plugs of young connective tissue become united to the alveolar wall, and the alveoli may become completely obliterated.

The masses of connective tissue in the bronchioles contain many blood vessels which are often of large size. The alveolar plugs almost without exception contain no blood vessels.

Walker, E. L. A Comparative Study of the So-called Polychromatophilous Degeneration of Red Corpuscles. From the Laboratory of Comparative Pathology of the Harvard Medical School. Journal Boston Society of Medical Sciences. November, 1899.

As the title indicates, Walker has approached the subject of the significance of the atypical staining erythrocytes from the side of comparative pathology. According to the view held by Ehrlich and his school the polychromatophilia of the red corpuscles represents a degenerative process.

By the study of blood corpuscles stained with basic dyes Walker has found these cells to be present in very considerable numbers in the blood of healthy animals. He examined the blood of the snake, frog, pigeon, house-mouse, rat, guinea-pig, rabbit, cat, dog, ox, horse, and man, finding the cells in question present in all but the ox, horse, and man. In birds and reptiles the number was higher than in mammals. He found further that the blood of the fœtal guinea-pig contained ninety times as many basophilous corpuscles as that of its mother. Similar results were obtained by comparing the blood of a dog with that of its fœtus. In a comparative study of the blood, and bone marrow of a

number of animals he found that the proportion of basophilous to normal red blood corpuscles was much greater in the spreads of the bone marrow, than in those of the blood. He concludes that "the universal presence of basophilous corpuscles as elements of the embryonic red blood corpuscular tissue in the healthy vertebrate marrow furnishes unqualified disproof that they are corpuscles showing changes due to pathological condition."

With regard to the relation of basophilous staining to the degree of hæmoglobin development in the erythrocyte he distinguishes four stages in the development of the corpuscle, as follows: (1) young and (2) mature normoblasts deficient in hæmoglobin and so basophilous, (3) macrocytes, which may be either basophilous or acidophilous, and (4) normocytes with full development of hæmoglobin and so acidophilous.

Walker claims that the examination of blood spreads stained with alkaline methylen blue gives a simple and easy means of diagnosticating the presence and degree of an anæmia. The presence of basophilous corpuscles indicates an anæmic condition, their number, the degree of the same. This method may even be used for differential diagnosis, as between malaria where there is considerable destruction of corpuscles, and a consequent increase in the basophilous corpuscles and a simple febrile disorder without great oligocythæmia when there would be no such increase.

Technique.—Make thin spreads of blood, dry, fix for fifteen to thirty minutes in alcohol and ether equal parts, stain five to ten minutes in Löffler's alkaline methylen blue, and examine in water. Nuclei of white corpuscles, malarial parasites and basophilous corpuscles blue, normal erythrocytes unstained.

W. R. B.

v. Marschalko. Plasma Cells. Centralb. für Allg. Path. u. Path. Anat. **10**: 21–22, 1899.

The plasma cell was first described by Unna in 1890. The chief characteristic which he claimed for it was a deep coloring of the protoplasm after staining with an old solution of methylen blue.

Later Jadassohn, v. Marschalko, and other writers described certain morphological characteristics as being more important.

Plasma cells when seen lying free are usually round or oval; when seen crowded together they are cuboidal, polygonal, or elongated. The protoplasm is non-granular, and is denser at the periphery. The nucleus is round, and has a very characteristic chromatin network containing five to eight coarse chromatin granules, usually at the periphery, and one, occasionally two, nucleoli. The nucleus is almost always eccentrically placed, usually at one pole of the cell. The cell may contain two, three, or even four nuclei. The protoplasm stains deeply with basic stains, especially with methylen blue.

The cells long ago described by Waldeyer as plasma cells have been proved to be "*mastzellen*," so there is now no objection to the use of the term "plasma cells" for the cells described by Unna.

Plasma cells may occasionally be found in normal tissue.

Unna claimed that they were derived from connective tissue cells. It is now generally believed that they develop from lymphocytes.

As the result of recent investigation, v. Marschalko believes that plasma cells

may form connective tissue cells. The plasma cells represent cell elements produced from lymphocytes by progressive cell activity on the part of the organism in the protection of itself in various reactive processes; they form the greatest part of the so-called round cell infiltration; and after persisting, usually a long time, either degenerate and disappear, or to some extent at least produce new connective tissue.

[The possibility of plasma cells forming connective tissue has probably occurred to every one who has worked on the subject; but upon close investigation has been quite generally considered improbable. Marschalko's conclusion certainly appears to be based on insufficient evidence.] R. M. P.

NEUROLOGICAL LITERATURE.

EDITH M. BRACE.

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131 Park Avenue, Rochester, N. Y.

Kolster. On the Histogenesis of Peripheral Nerves. Ziegler's Beiträge, **26**: 190, 1899.

In a study of the nervous system of the embryos of the salmon, rat, rabbit, and man, Kolster seeks to determine whether the formation of the sheath of Schwann is connected with the development of the myelin. The Golgi method was used.

The advancing ventral root as it grows from the cord pushes ahead, and as a result is partially enveloped by the single celled layer of connective tissue which surrounds the cord. No nuclei are present inside this layer; nothing but naked axis cylinders, which increase rapidly in number and but slightly in size. The development of myelin begins in the central nervous system and proceeds rapidly to the periphery. The sheath of Schwann develops soon after. This is the order of development in fishes, but in birds and rabbits the mesodermic cells enclosing the roots proceed into the bundle before any myelin is present.

Hence Kolster concludes that there is no connection between the development of myelin and the sheath of Schwann. The myelin and axis cylinder are both of ectodermal origin and the sheath of mesodermal origin. A. M.

Eigenmann, Carl H. The Eyes of the Blind Vertebrates of North America. I. The Eyes of the Amblyopsidæ. Arch. f. Entwick. mechan. d. Organis. **8**: 545–617, pls. xi–xv, and ten text figs., 1899.

The eyes of all known species of Amblyopsidæ are described in this paper, and from the exhaustive observations made, some conclusions are drawn with reference to heredity. The family contains at least six species, two with well developed eyes living in surface streams, one with well developed and two with greatly degenerate eyes living in subterranean streams. Dr. Eigenmann considers that Nature is here conducting a vast experiment in evolution, and without the assistence or intervention of natural selection.

He finds the key to the situation in the negatively heliotropic *Chologaster papilliferus*, which, although it has better developed eyes than any other species of the family, procures its food by means of highly developed tactile organs, and uses its eyes only to avoid the light. In *Amblyopsis* there is total lack of func-

tional eyes, as well as negative heliotropism. Eyes are lost as the indirect result of the high development of tactile organs, and their degeneration can only be explained as the result of the transmission of disuse effects. As in all organs no longer of use or hindrance, and not under the control of selection, individual variations are great, and in addition there are marked changes due to age.

The process of degeneration in Amblyopsidæ is one of growing smaller and simpler, not a cutting off of late stages in development, and it does not result from an ingrowth of connective tissue, but instead there is a starving and shriveling or a resorption of parts, and degeneration does not proceed in the reverse order of development, but the older ontogenetic stages have been modified into the more recent phyletic stages. The most degenerate eyes do not approach the condition of the pineal eye.

As long as an eye is functional the lens and the whole dioptric apparatus does not degenerate, but with absolute disuse the lens disappears and the eye collapses. When degeneration begins there is reduction in the number of horizontally repeated elements, but the vertical complexity is not greatly modified at first. In some species degeneration begins in the eye of the embryo. In *Papilliferus* the pigment layer is much thickened in old individuals, and *Amblyopsis spelæus* presents the remarkable condition of unchanged orbital notches with diminution in the size of the eye. In *Typhlogobius* the eye is always functional to some extent and in a condition of partial use; here the lens is not affected, but the retina has been considerably reduced horizontally.

Methods mentioned are depigmentation with chromic acid and staining with Biondi-Ehrlich; killing in Perenyi, followed by staining with hæmalum; killing in picric acid and staining with hæmalum and indigo-carmine. E. M. B.

Schmidt, Dr. H. Ueber die Darstellung der Begleit-und Gliazellen im Nervensystem von Helix, mit der Golgimethode. Arch. f. Mikr. Anat., **55**: 300–313, Tf. 18, 1900.

Preparations of the snail's nervous system were made by the Golgi method. The writer finds three groups of "*Begleitzellen*" which he thinks are connective tissue cells. The first group consists of multipolar cells with branched processes found in the motor and sensory tracts from the buccal ganglion of *Radula*. Their processes lie close to the nerves, from which they are distinguished only by their color reaction, which varies from reddish brown to sepia, while the nerves are black. The cells of the second group are larger, and more fleshy in appearance. The processes of both groups are mostly perpendicular to the nerve fibrils. The third group is similar to the first. These cells spin themselves around the ganglia, nerve trunks, and commissures.

A unique type of cell is found among the fibrils in the nerve trunks and commissures, which are divided into somewhat three-sided prism form by radially placed septa, formed mostly by characteristic supporting cells. The single cells are small and elongated, with numerous processes, all alike, extending from the ends. The long axis of the cells is parallel with the nerve trunk, but the processes bend toward the periphery, and usually each cell sends a process into the adjourning septum. Careful staining brings out a perfect

system of fibers extending through the cells and into the processes, and in addition a finer network lying between these fibrils. Nuclei were not made out with certainty. There appears to be no union between these fibrils and the nerve fibrils.

Near the union of the longitudinal commissures with the ganglia and in the intraganglionic portions there are elongated cells transitional in form to the intranervose cells. Their processes lie perpendicular to the nerve processes, and have a foot-like expansion where they rest on the neurolemma sheath.

In the pedal and visceral ganglia, multipolar cells surround single large ganglion cells or several small ones. In groups of small cells these sheath cells assume fantastic forms, winding around the cells and grasping them right and left with their processes.

The elongated fibrous cells are independent of the neurolemma, and the connection between fibrils and protoplasm suggests the glia cells of the vertebrates, a resemblance which is increased by the surrounding of the ganglion cells with multipolar cells related to these glia cells through transitional forms.

E. M. B.

Eickhoff, K. Ueber die Erregbarkeit der motorischen Nerven an verschiedenen Stellen ihres Verlaufes. Arch. f. Physiol., **77**: 156–195, 1 pl., 5 text figs., 1899.

The writer emphasizes the view which is constantly gaining favor that the nerves must be looked upon as a "bundle of living arms," which extend out from the ganglion cells, the primary elements of the nervous system, and that, like these, they have specific differences and are capable of qualitatively different reactions to stimuli.

Although normally a nerve is stimulated only at the end, stimuli may be brought to act upon it at various places in its course.

Experiments were made upon the grass frog to determine the various reactions to electrical, chemical, and mechanical stimuli in different parts of the sciatic nerve, and as it made no appreciable difference whether the nerves were connected with the spinal cord or not, most of the experiments were made on cut nerves.

Under electrical stimulation the upper part of the nerve shows more irritability than the lower portion, and this excess of irritability was not limited to the region of the cross section.

The nerve was chemically stimulated with glycerine (2 pts glycerine, 1 pt. water), and with salt solution (5.84 per cent.). The upper part of the nerve reacted much later, frequently fifteen minutes later than the lower portion, and the character of the reaction was different in the two parts. Contraction was less violent in the upper part and there was no tetanus, while there was strong tetanus in the lower part. It is difficult to understand this great difference in the reactions.

The upper part of the nerve was much more responsive to mechanical stimuli than the lower part. Irritability is greatest about the middle of the plexus, but soon decreases, and later the lower part of the nerve is most irritable.

E. M. B.

NOTES ON RECENT MINERALOGICAL LITERATURE.

ALFRED J. MOSES AND LEA MCI. LUQUER.

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V. Goldschmidt.

Goniometer mit zwei Kreisen. Zeit. f. Kryst. **21**: 210–232, 1892.

Phosgenit von Monteponi. *Ibid*, 321–328.

Ueber Projection und Graphische Krystallberechnung. Berlin, 1887.

Projection auf eine andere als die Normale Ebene. Zeit. f. Kryst., **17**: 194, 1890.

Das Zweikreisige Goniometer (Modell, 1896). Zeit. f. Kryst., **29**: 333–345, 1898.

Index der Krystallformen der Mineralien. Bd. **1**: 1886.

Krystallographische Winkeltabellen. Berlin, 1897.

The principal contributions of Dr. Goldschmidt to the comparatively new method of crystal measurement are referred to in the above list. In this method, instead of measuring the angles between the faces, each face is determined by two coördinate angles measured on a horizontal and a vertical circle, and these fix the position of the face with respect to a pole and a meridian very nearly as the latitude and longitude determine a point upon the surface of the earth.

The Goniometer.—In Fig. 1, *H* represents the horizontal graduated circle to which is attached the vertical graduated circle *V*, which in turn carries the crystal holder and the crystal. The collimator *C* is fixed, and the telescope *F* is always centered on the intersection of the axes of *H* and *V*, but revolves independently upon the axis of *H*. The details of crystal carriers, verniers, signals, fine adjustments, are given in the description, but can be usually understood from Fig. 1.

The Object of the Method of Measurement.—The object is to obtain by rotation of the crystal around two axes at right angles to each other, two angles for each face, corresponding, the one to the geographical longitude from a fixed meridian, the other to the complement of the latitude measured from a fixed pole.

From these two coördinate angles there are calculated, by simple formulæ: rectangular coördinates by means of which the positions of the faces may be readily plotted in gnomonic projection; polar elements analagous to the axial ratios *a*, *b*, *c*; linear elements essentially the axial ratios; and polar symbols which are rational numbers designating the faces.

The Advantages of the Method.—The principal advantages are:

a. That with one adjustment of the crystal the necessary constants for all faces are obtained, whereas, in the one circle goniometer, a readjustment is necessary for each zone.

b. These constants, two for each face, determine the position of each face with respect to every other face. For *n* faces there would be necessary only 2 *n* angles, whereas, for the same completeness with the one circle goniometer, *n* (*n*—1) angles would have to be obtained and recorded.

c. In the calculation of the elements, instead of using one selected face,

every face yielding good reflections may be simply utilized, thus greatly reducing the probability of error.

d. The easily calculated rectangular coördinates yield at once a gnomonic projection on which elements and symbols may be graphically determined, and from which all other projections, clinographic, orthographic, and stereographic, can be made.

The principal disadvantage is that the zonal equations possible with the Miller indices are not applicable.

Obtaining the Reading on H for the Polar Face.—A face is in polar position when parallel *V*, Fig. 1. The telescope is clamped at a convenient angle to the

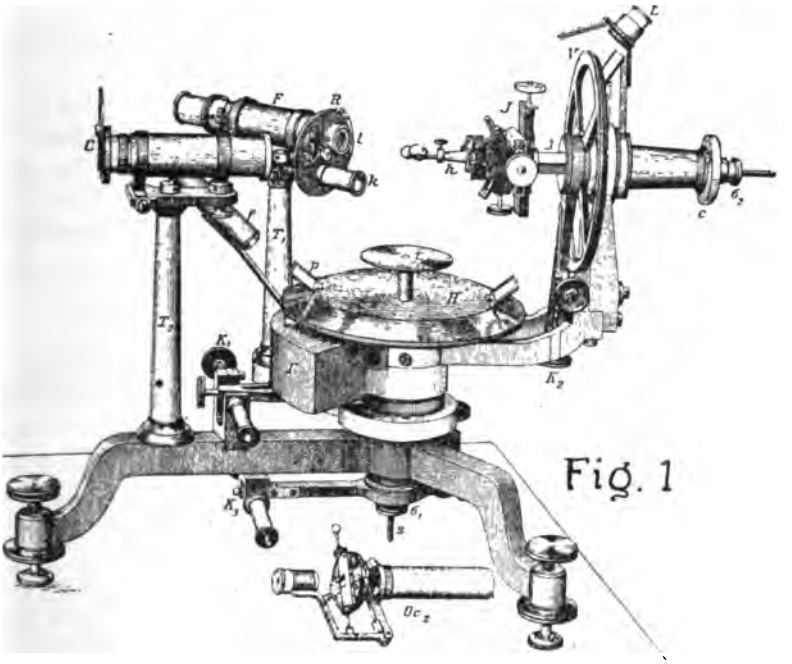


Fig. 1

collimator, and a plane reflecting surface, such as a cleavage, is mounted centered and made approximately parallel to *V*. By turning *V* and *H* a reflection is obtained and *H* is read. *V* is then turned 180° and clamped, and *H* turned until a reflection is again obtained and *H* again read. The mean of these two readings, or h_0, is the reading on *H* for the pole face for that particular position of collimator and telescope.

Adjusting the Polar Face.—Usually the crystal is mounted with the prism faces normal to *V*, in which case the polar face is normal to the prism face. If the prism faces are lacking or indistinct, another zone parallel to one of the basal axes is mounted normal to *V*, and the results later transformed by appropriate formulæ.

If the selected polar face is present it is adjusted by mounting approximately, centering one corner of the face, then placing *H* at h_0, clamping and obtaining a reflection by use of the centering device *J*, Fig. 1. This reflection must remain constant during complete revolution of *V*.

If the polar face is not present, a prism edge is made parallel to the horizontal cross hair, H is clamped at $h_0+90°$ and the reflection obtained by use of the centering device J.

Obtaining the Coördinate Angles of any Face.—By revolving V and H until the desired face gives a reflection, two readings, v and h, are obtained, from these are deducted the readings respectively for the meridian face and the polar face, the remainders are the coördinate angles denoted by φ and ρ; that is, from V we obtain $v-V_0=\varphi$ the prime meridian usually being the pinacoid 010. From H we obtain $h-h_0=\rho$.

These values φ and ρ are constant for any face, whatever the position of telescope and collimator. φ varies from 0° to 180° from the meridian, and is + in the direction of the hands of a watch. ρ varies from 0° to 90° from pole to equator.

Obtaining Rectangular Coördinates from φ and ρ.—If O, Fig. 2, is the projection of the polar face, and $O\ Q$ of the prime meridian on a plane parallel to the polar face, then the projection of any face F with coördinate angles φ and ρ is on $O\ F$ at an angle φ to $O\ Q$, and at a distance $O\ F$ dependent on the value of ρ and the distance $O\ M$ of the plane of projection from the center M of the crystal.

Denoting $O\ M$ by 1 $O\ F=tan\ \rho$.

$x=O\ F\ sin\ \varphi=tan\ \rho\ sin\ \varphi$ and $y=O\ F\ cos\ \varphi=tan\ \rho\ cos\ \varphi$

That is, x and y are rectangular coördinates of F on a plane parallel V at a distance $O\ M=1$ from the center of the crystal, and are measured from O the pole, and $O\ Q$ the meridian.

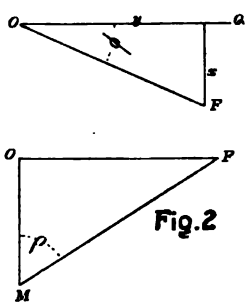


Fig. 2

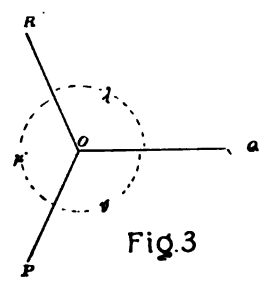


Fig. 3

Polar Elements and Polar Axes.—The polar elements p_0, q_0, and r_0 are distances from the center on lines $O\ P$, $O\ Q$, $O\ R$ (Polar Axes), Fig. 3, normal to the three pinacoids, and in length are determined by the intersection of a face of the unit pyramid with these lines.

The angles between the lines are designated as in the figure.

Polar Symbols.—The intercepts of any face on $O\ P$, $O\ Q$, $O\ R$ may be written as pp_0, qq_0, and rr_0 respectively, r and r_0 may both be taken as unity since only relative values are concerned. The quantities p and q correspond closely to the indices of Miller and to the reciprocals of the indices of Weiss, they are rational numbers, and pq may be called the polar symbol of the face.

They correspond closely to the first two of the Miller indices when the third is made unity.

For example, in barite the corresponding Miller indices and Goldschmidt symbols for certain faces are 014, $0\frac{1}{4}$; 108, $\frac{1}{8}0$; 112, $\frac{1}{2}$; 414, $1\frac{1}{4}$, etc.

Calculation of the Polar Elements and Symbols from the Rectangular Coördinates.

ISOMETRIC.—In this system a face of the unit pyramid (octahedron) intersects the polar axes at equal distances $p_0=q_0=r_0=1$. Hence, the intercepts of any face on these axes are p, q and $r=1$, and the polar symbols coincide with the rectangular coördinates x and y of the face, that is, $x=p$, $y=q$.

TETRAGONAL.—In this system a face of the unit pyramid intersects the polar axes at distances $p_0=q_0$ and $r_0=1$. The intercepts for any face on these axes are pp_0 and qp_0 which coincide with the rectangular coördinates of the face, that is, the polar symbols are $p=\frac{x}{p_0}$ $q=\frac{y}{p_0}$

Evidently also $p_0=\frac{x_1}{p_1}=\frac{x_2}{p_2}= \ldots \frac{x_n}{p_n}=\frac{y_1}{q_1}=\frac{y_2}{q_2}= \ldots \frac{y_n}{q_n}$

That is, the elemental value p_0 may be based on a summation of all the measurements

$$p_0=\frac{1}{2_n}\left(\frac{x_1}{p_1}+\frac{x_2}{p_2}+ \ldots \frac{x_n}{p_n}\right)+\left(\frac{y_1}{q_1}+\frac{y_2}{q_2}+ \ldots \frac{y_n}{q_n}\right)$$

For the unit pyramid $p_0=x=y$.

If p_0 is known, then the symbol $p\,q$ results from the rectangular coördinates

$$p=\frac{x}{p_0} \quad q=\frac{y}{p_0}$$

ORTHORHOMBIC.—In this system a face of the unit pyramid intersects the polar axes at distances p_0, q_0, and $r_0=1$. Again the intercepts of any face on these axes coincide with the rectangular coördinates, hence

$$p=\frac{x}{p_0} \qquad q=\frac{y}{q_0} \qquad p_0=\frac{x_1}{p_1}=\frac{x_2}{p_2}=\frac{x_n}{p_n} \qquad q_0=\frac{y_1}{q_1}=\frac{y_2}{q_2}=\frac{y_n}{q_n}.$$

The elemental values p_0 and q_0 may be based on a summation of all measurements.

$$p_0=\frac{1}{n}\left(\frac{x_1}{p_1}+\frac{x_2}{p_2}+ \ldots +\frac{x_n}{p_n}\right) \qquad q_0=\frac{1}{n}\left(\frac{y_1}{q_1}+\frac{y_2}{q_2}+ \ldots +\frac{y_n}{q_n}\right)$$

MONOCLINIC.—In this system the projection O of the basal pinacoid, Figs. 4 and 5 no longer coincides with the projection C of the polar face, the polar axes passing through O are parallel to the directions of the rectangular coördinates. Denoting CO by e we have

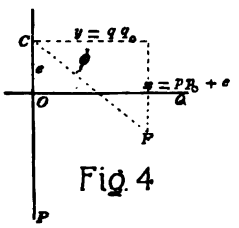


Fig. 4

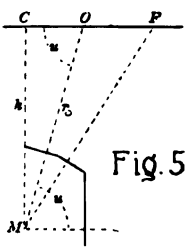


Fig. 5

(Fig. 4), $x=e+pp_0$ $y=qq_0$ $p=\frac{x-e}{p_0}$

$q=\frac{y}{q_0}$, hence $x_1-e=p_1p_0$ $x_2-e=p_2p_0$ $x_1-x_2=p_0(p_1-p_2)$, or $p_0=\frac{x_1-x_2}{p_1-p_2}$

or in summation of many faces $p_0 = \frac{2}{n}\left(\frac{x_1 - x_2}{p_1 - p_2} + \ldots \frac{x_n - x_{n-1}}{p_n - p_{n-1}}\right)$

And as in orthorhombric $q_0 = \frac{y_1}{q_1} = \frac{1}{n}\left(\frac{y_1}{q_1} + \frac{y_2}{q_2} + \ldots \frac{y_n}{q_n}\right)$

In this system it is to be noted (Fig. 5) that if $h = MC = 1$, the values of x and y for any face are determined as previously described, but if $r_0 = MO = 1$, then $MC = MO \sin \mu = \sin \mu$, and $x = \tan \rho s \text{ in } \varphi \sin v$, $y = \tan \rho \cos \varphi \sin \mu$.

TRICLINIC.—Similar but more complex values are obtained for this system, for which the reader is referred to *Zeit. f. Kryst.*, **21**: 221, 222.

HEXAGONAL.—For this system a different treatment is essential, see *Zeit. f. Kryst.*, **17**: 194, **21**: 228, and *Index der Krystallform*, **1**: 32.

EXAMPLE.

In an orthorhombic crystal of topaz (Fig. 9), the coördinate angles of the faces m, l, c, y, p, and i having been obtained by measurement, it is desired to

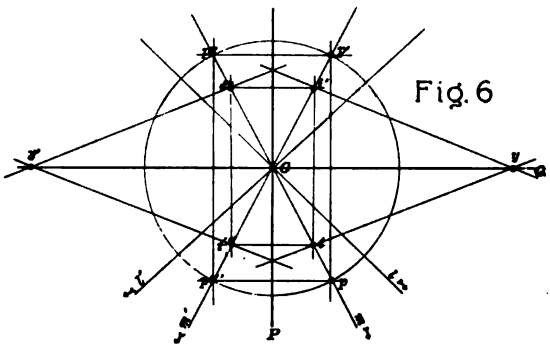


Fig. 6

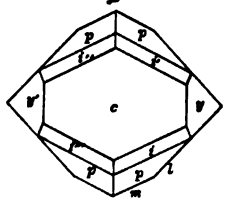


Fig. 7

obtain the gnomonic projection, and from this the orthographic and clinographic projections; and to determine the polar elements and polar symbols, p being taken as the unit plane.

Calculation of Angular Coördinates.

$$x = \tan \rho \sin \varphi, \text{ or } lx = l \tan \rho + l \sin \varphi.$$

$$y = \tan \rho \cos \varphi, \text{ or } lx = l \tan \rho + l \cos \varphi.$$

The vertical faces m and l are projected at infinity, on lines the slope of which is given by $\frac{x}{y} = \tan \varphi$.

Face.	φ	ρ	$\frac{x}{y}$	x	y
m	62°8′	90°	1.892	:	
l	43°25′	90°	.9461	:	
c	0°	0°		0	0
y	0°	62°20′		0	1.907
p	62°8′	45°35′		.9024	.4770
i	62°8′	34°14		.6015	.3180

The Gnomonic Projection.—Lines are assumed to be drawn from the center of the crystal normal to each face, and prolonged until they cut some chosen plane tangent to the circumscribing sphere. Each face is then represented by a point, and each zone by a straight line. Draw circle (Fig. 6) with radius =1.

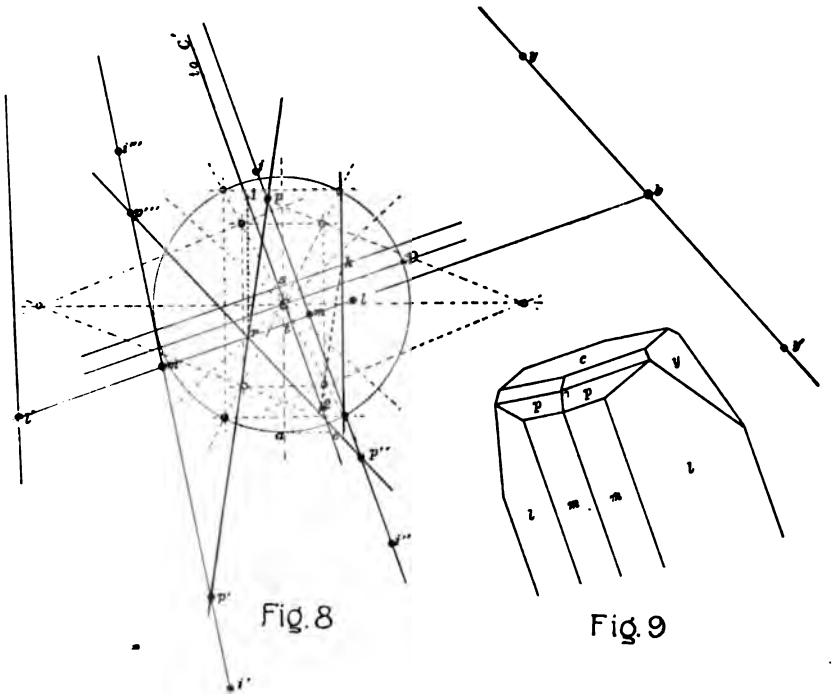


Fig. 8 Fig. 9

Through the center C draw $C\,Q$ left to right, $C\,P$ front to back. Then, because the system is orthorhombic, these are the polar axes. Lay off x parallel $C\,P$ and Y parallel $C\,Q$, obtaining poles p, i, and y, and the corresponding poles in the other quadrants. By the ratios $\frac{x}{y}$=1.892 and .9461, the diagonal lines are obtained on which the poles of m and l lie at an infinite distance.

Obtaining Polar Elements.—If p is the unit face the values of x and y for p are the polar elements, that is, p_0=.9024+q_0=.4770. In Goldschmidt's Winkeltabellen p is $\frac{1}{2}$, that is p_0=.9024×2=1.8048+q_0=.4770×2=.9540.

Obtaining Polar Symbols.—For each face $pp_0=x$, $qq_0=y$, that is, $p=\frac{p_0}{x}$, $q=\frac{q_0}{y}$.

For example: if $p_0=1.8048$, $q_0=.9540$, the polar symbols are $\frac{.6015}{1.8048}=\frac{1}{3}=p$, and $\frac{3180}{9540}=\frac{1}{3}=q$, or briefly $\frac{1}{3}$.

Obtaining Orthographic Projection.—The edges between any two faces (Fig. 7), are at right angles to the line connecting their projections in Fig. 6.

Obtaining Clinographic Projection.—A new gnomonic projection is obtained corresponding to the crystal after a horizontal and a vertical rotation. The conventional figure results from the following construction (Fig. 8): The dotted lines are a reproduction of Fig. 6 of the ordinary gnomonic projection, r is radius of circle.

Lay off $ae=\frac{1}{3}r$ to the left. Draw a central line from e through C, prolong it to some point C^1 (not shown), making $CC^1=7\,r$. Make $Cs=Ct=\frac{1}{7}r$, and draw *normals* to CC^1 through s and t.

Find the "cross points" 1 and 2 on CC^1 respectively from s and t with radius sD.

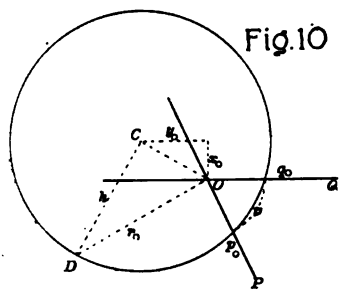
The new projection of any zone line, for instance pp^1, Fig. 8, is found as follows:

Through 1, Fig. 8, draw a parallel to pp^1, it intersects the lower normal at r. Through k, the intersection of the zone with the upper normal, draw $k\,2$ to the cross point 2. From r draw line parallel to $k\,2$, it is the desired new projection of pp^1. (For proof see *Project. u. Graph. Kryst.*, p. 69.)

In this way the various zones are obtained, and their intersections are the face projections.

The face projections, prisms, and pinacoids all lie on the normal through t, except the base, which is projected at C^1 (not shown).

The edges in the clinographic projection are each normal to the lines connecting their projections as transformed, that is, the edge between p and l, Fig. 9, is normal to a line connecting p and l, Fig. 8, or the edge between y and l, Fig. 9, is normal to the line connecting y and l, Fig. 8.



The old axial directions, axial cross, may be found by connecting the projections of a, b, c with C.

In a more general case, as in the triclinic, the coördinate angles give, as before, the rectangular coördinates, the formulæ for their calculation being a little more complex. The intersection O of the polar axes is found in gnomonic projection, Fig. 10, by the cördinates x_0 and y_0 calculated for the basal pinacoid, the polar axis Q is drawn through Q from left to right, and the polar axis P is laid off at the measured angle γ to Q. The unit value r_0, the distance from O to the center of the crystal, is found by drawing CD normal to CO, then is $DO=r_0$. p_0 and q_0 are laid off on OP and OQ in terms of r_0.

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On the Rapid Conversion of Haematoxylin into Haematein in Staining Reactions.

Since it was shown by Mayer* that the slow process, known as "ripening," through which hæmatoxylin solutions must pass before they become capable of producing staining effects, is due to the oxidation of the hæmatoxylin into hæmatein, many workers have abandoned entirely the older solutions, and employ in their stead the more easily prepared and generally better hæmatein solutions, as recommended by this great microscopist. Notwithstanding that there is no doubt that Mayer's hæmatein stains are superior to the usually so-called hæmatoxylin ones, they have not been so universally adopted as their merits would warrant, owing to the facts that hæmatein is often quite difficult to obtain, that it costs in the market more than three times as much as hæmatoxylin, and more than all, it is often of such inferior quality that the solutions prepared from it will scarcely stain at all. About three years ago I began a series of experiments with the view of getting rid of these varied objections by instantaneously oxidizing the hæmatoxylin into hæmatein in the staining solution. At the outset it was apparent that whatever oxidizing agent should be employed, it would be very desirable that both it and any substance or substances which might result from the chemical changes, should be insoluble in water, and that they should not become chemically united to the hæmatein produced. After some investigation it was found that these very desirable ends could be attained by the use of mercuric oxide, in either the red or yellow form, and this fact I announced somewhat over a year ago.†

The solution first made, although much stronger, corresponds closely to Mayer's hæmalum, and when properly employed gives a stain in no way inferior to it. The formula of this stain as first employed by me is as follows:

Hæmatoxylin, ...	1 g.
Alcohol, ...	10 cc.
(Dissolve hæmatoxylin in the alcohol). . .	
Alum (ammonium or potassium), ...	20 g.
Distilled water, ...	200 cc.

Dissolve the alum in the water by the aid of heat, and add the hæmatoxylin solution. Bring the mixture to a boil as rapidly as possible, and then add a half

* Mayer, Zeit. f. Wiss. Mik., VIII, 3, 1891.

† Harris, The Micros. Bull., December, 1898, pp. 47.

gram of mercuric oxid. The solution at once assumes a dark purple color. As soon as this occurs remove the vessel containing the solution from the flame, and cool by plunging at once into a basin of cool water. As soon as cool the solution is ready for staining. This solution keeps for years in a well stoppered bottle. I have some of it which was prepared twenty-seven months ago, and it stains quite as well as when fresh. It is a noticeable fact that this solution gradually turns redder with time; this is the result of the gradual decomposition of some of the alum, and the liberation of a certain amount of the sulphuric acid radical. This does not injure the stain,—it appearing to me that the nuclear staining is even sharper than when the solution is fresh. In a recent criticism on this stain Mayer* remarked that it is too strong, and that if diluted the nuclear effect is improved; in this I heartily concur,—I having almost always employed it very much diluted. This dilution may be brought about while the stain is being made, or it may be done afterward. In the former case the proportion of alum solution may be increased to any extent that may be desired, but it is perhaps better not to use more than 2000 cc.; the relative proportions of alum and water should be adhered to, however great the quantity used. I have generally, as already remarked, used the strong solution, and diluted it for use to whatever extent seemed desirable. Perhaps the best results are obtained by pouring just enough of the strong solution into distilled water, or alum-water, to impart to either of these a dark purple color. It would appear not improper to call this solution *hæmalum*, inasmuch as it is modelled after and is essentially identical with Mayer's hæmalum.

Soon after it was determined that hæmatein could be satisfactorily produced directly from hæmatoxylin in solution, the idea very naturally suggested itself that the various hæmatein stains other than the simple alum solution might also be made in this way, and on trial, it has been found that this is the case.

One of the best of all the hæmatein stains is Mayer's *acid hæmalum*, which was imagined by him as a substitute for Ehrlich's acid hæmatoxylin. My solution which corresponds to it is prepared by simply adding 4 per cent. of glacial, or 8 per cent. of common acetic acid to the solution which has just been described. In case the hæmalum stain is prepared with an increased amount of alum solution, the proportion of acetic acid should be less. This stain may be used undiluted for staining purposes, or what is better, though it takes considerably longer, a small quantity of the solution may be added to either pure water or to an aqueous alum solution. For general purposes I am acquainted with no nuclear stain which is so good as a very dilute solution of this stain, or Mayer's acid hæmalum, in a saturated solution of alum in water. In case the stain is employed in a pure state the staining is almost instantaneous, but I have never seen over-staining occur, however long the sections were exposed to its action. The nuclei of cells are stained in this way a purplish red color, while the protoplasm is scarcely colored at all. After staining in the pure stain the nuclei may be made to assume a dark purple color by placing the section in water from ten to thirty minutes. In the dilute solution of this stain the nuclei are not stained so red as when the stain is used in a pure form, and the proto-

*Mayer, Zeit. f. Wiss. Mik. XVI, pp. 196–220, 1899.

plasm of the cells may be said not to be colored at all, if the section is not left in the solution too long.

Mayer found some difficulty in keeping his hæmalum solution, but ascertained that by the addition of glycerine the stain keeps much better. While I have not had this difficulty with my solutions—which may be due to the climate—it seemed desirable to prepare a glycerine solution in case that the stain should be found not to keep well in other places. This has been done by simply adding 30 cc. of glycerine to 70 cc. of my hæmalum. This stain keeps well, and stains very nearly as well as the hæmalum. Following Mayer, I call this *glychæmalum.*

I have also prepared a *hæmacalcium* to correspond with Mayer's solution of the same name. Two solutions are prepared as follows:

(A)	Hæmatoxylin, ...	0.5 g.
	Aluminium chloride, . .	0.5 g.
	Acid acetic (glacial), . .	2.5 cc.
	70 per cent. alcohol, . .	150.0 cc.

Dissolve the hæmatoxylin and aluminium chloride in the alcohol, bring the solution to boil, and add gradually 1 g. of mercuric oxid. The solution quickly assumes a dark purple color; as soon as this happens, remove from the flame and cool rapidly. The acid may be added before or after boiling.

(B)	Calcium chlorid, . . .	25.0 g.
	Acid acetic, ...	2.5 g.
	70 per cent. alcohol, . .	150.0 cc.

Dissolve the calcium chlorid in the alcohol. The two solutions may be mixed and kept in this way, but it is preferable to mix them in equal parts just before staining. This stain is not as good as any of the preceding, but is useful in those cases where an alcoholic stain only can be employed,

Notwithstanding that Delafield's hæmatoxylin can no longer be considered as standing in the front rank among those stains, there are many who still use it for general work. The stain certainly has the advantage that it is very powerful, and may therefore be useful for very refractory material; it also gives a very useful plasma stain. This stain may be prepared by my method as follows:

Hæmatoxylin, ...	1.0 g.
Alcohol, ...	6.0 cc.
(Dissolve hæmatoxylin in the alcohol and add.)	
Saturated alum solution in water, . . .	100.0 cc.

Boil and add 0.5 g. mercuric oxid. As soon as the liquid becomes of a dark purple color remove from the flame, and cool rapidly. After cooling add 25.0 cc. each of methylic alcohol and glycerine. The stain is ready for use at once.

Among the most useful of the hæmatein stains are those devised by Mayer for the purpose of staining mucin in a differential manner, and called by him *muchæmatein.* These, I find, can also be made readily by my process. The methods are as follows:

Aluminium chlorid, . . .	0.1 g.
Hæmatoxylin, ...	0.2 g.
70 per cent. alcohol, . .	100.0 cc.

Dissolve the aluminium chlorid and hæmatoxylin, and then carefully bring the solution to a boil, and add gradually mercuric oxid 0.6 g.; after the solution turns to a dark purple color, remove from the flame at once and cool. A drop of hydrochloric acid should be added to the mixture before or after boiling.

If an alcoholic solution be undesirable, the 70 per cent. alcohol of the above formula may be replaced by equal parts of glycerine and water, and the stain made in the same way with the exception that I find that 0.3 g. of mercuric oxid is enough to properly oxidize the hæmatoxylin into hæmatein in this case. A drop of hydrochloric or nitric acid may be added, but it is not necessary. In the preparation of these stains it is not at all necessary to adhere strictly to the proportion of hæmatein given in the formulæ, for the amount of this substance used may often be changed with advantage—especially in the direction of lessening the quantity. However, I have usually adhered rather closely to the proportions given by Mayer, who, as every one knows, is the greatest authority on the subject.

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Stock Cultures and Color Preservation.

Sealing tubes to prevent cultures and culture media from drying out is practiced in many laboratories, but as there are still places where such methods have not been adopted, a note on this subject may be appropriate.

In southern California unsealed cultures dry out very rapidly during the summer months, and it has been found necessary to renew all cultures frequently, or to prepare stock cultures by sealing them against evaporation. For such organisms as will thrive upon potato, including a very large series, sealed stock cultures are now prepared in both tubes and Petri plates. For potato tubes, about an inch of loose cotton is forced to the bottom of each tube with a glass rod or stick, one-half inch of distilled water is now added, but not enough to reach the top of the cotton. A potato plug properly fitted and beveled is dropped upon the cotton and the tube is carefully plugged in the usual manner. The tubes thus prepared are thoroughly steamed for an hour. For this work it is thought better to steam for an hour and allow the tubes to cool in the steamer than to steam by the intermittent process—the potato is not as apt to become water-soaked and soggy. After inoculation, the cultures are allowed to grow until they are found to be satisfactory. The cotton plugs are then cut off with shears even with the ends of the tubes. The plugged ends of the tubes are flamed and each cotton plug is carefully pushed into the tube from one-sixteenth to one-eighth of an inch. A little melted paraffin is poured over the end of the cotton and allowed to soak in and cool. A beaker of melted paraffin is kept over a water bath for this purpose, and a common tinned iron spoon is used in the work. After the paraffin first applied has hardened, the space in the end of the tube above the cotton plug is filled with paraffin in like manner, and the tube is set upright in a rack to cool. Cultures thus sealed will commonly keep in a living condition and with fresh appearance from six to twelve months. When it is desired to

obtain new cultures from such sealed tubes, the point of a scalpel is run around the glass to cut the paraffin free, when the plug may be easily removed. After the desired renewals are set, the plug is again sealed into the tube by the use of a heated scalpel.

Potato cultures in Petri plates are sealed with paraffin in like manner. After the culture has stood for a short time, the slice of potato will usually adhere to the bottom of the dish so that the latter may be inverted without the potato changing position. The two halves of the plate are held firmly together in this inverted position while a little hot paraffin is poured into the space between the top and bottom of the dish and caused to flow around the entire circumference by tipping the plate. As soon as the first paraffin is cool, more may be poured in until the plate is effectively sealed. Such sealed Petri plate cultures will keep fresh for many months, as in the case of the tubes, and furnish most excellent cultures for study and exhibition. These sealed plates are also free from the danger of infection by fungi, mites, flies, etc.

Beside the advantage of always having stock cultures for renewal and study there is the advantage of having, by this means, cultures which retain the normal color of fresh cultures for long periods of time. This retention of color is a great aid in the comparative study of many chromogenic organisms, and characteristic descriptions may be drawn with much greater reliability from such sealed cultures than from those in all stages of desiccation, as is not infrequently done.

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Staining the Envelope of Certain Ascospores.

The ascopores of certain Pyrenomycetineæ are surrrounded by a hyaline envelope of varying thickness. This is especially common in the family *Massariaceæ*, only one genus of which lacks the envelope. Owing to its hyaline nature, and to the fact that its refractive index is not far from that of the mounting media, it is frequently desirable to stain this envelope. In attempting to do this, I found it very resistent to the usual stains.

Owing to their large size and the ease with which they were to be obtained, I found the ascospores of *Massaria inquinans* (Tode) especially favorable for experiment. Exclusive of the envelope, which, as shown below, varies greatly in thickness, the spores average about $80 \times 18 \mu$. They are very easily obtained by scraping with a moist scalpel the surface of the wood in which the perithecia are embedded.

That the hyaline covering is not of ordinary cellulose is readily shown by its failure to respond to the iodine and sulphuric acid test. Its gelatinous nature may be very nicely seen by mounting the spores in strong alcohol (95 per cent.) and allowing a drop of water to flow under the cover glass. The membrane, at first almost invisible, quickly imbibes the water and swells excessively. This experiment illustrates a frequent source of error in spore measurements. The

membrane, the thickness of which varies with the amount of water present, should not be included in such measurements.

The gelatinous nature of the envelope indicates that the best results in staining are to be expected from the use of aqueous solutions, or those containing but a small per cent. of alcohol. I shall mention but a few of a number tried.

The envelope was unaffected by even a forty-eight-hours immersion in a one per cent. solution of eosin. The same was true of fuchsin and safranin. Delafield's hæmatoxylin proved but little better, for though a prolonged action tinged the envelope to a slight extent, the time required made its use impracticable.

Of the stains tested, Bismark brown in strong aqueous solution proved by far the most satisfactory. Even with it the stain was but slight. An action of fifteen minutes was sufficient, though it was impossible to overstain. The spores were then washed in water and mounted in glycerine jelly. Such preparations a year old are still as satisfactory as when first made.

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The Bacteria in the Stomach of the Cat.

JULIUS WEISS.

IV.

The discussion with reference to the digestive powers of bacteria may be said to have received its stimulus by Pasteur (37). He is reported by Duclaux to have been of the opinion that bacteria are necessary in digestion; and it is also reported by others that he even believed that life could not exist without their presence in the digestive tract. Opinions of this nature, coming from such high authority, were not to be set aside easily, neither were they to be overthrown by mere theoretical reasoning. Indeed, such opinions were very prevalent and widespread in his day. Even at the present time, the most posted physiologists are non-committal on this subject.

The subject naturally excited the curiosity of a number of investigators, which resulted in various experiments of more or less importance, a summary of which will now be given.

Abelous (19), in 1889, by allowing some of the organisms he isolated from the stomach contents to act upon alimentary substances, found that a number of them could coagulate milk, and redissolve the coagulum; that they could dissolve coagulated egg-albumin, fibrin, and gluten; that some of them could, more or less rapidly, transform lactose into lactic acid, and produce alcohol and gas in glucose; and finally, that some of them had a more or less amylolytic action on starch. From this he concluded that bacteria can produce peptones and sugars from proteids and starch respectively.

McFayden, Nencki and Sieber (38), in 1890–1, made observations in the case of a woman with a natural fistula in the small intestine, immediately above the cæcum. They found that the intestinal contents, as they passed out through the fistula, were constantly acid. They also observed that no putrefaction of proteids occurred in the small intestine, but that fermentation of carbohydrates

did occur regularly when such substances were ingested. They concluded from these observations that bacteria do not produce peptones, and that digestion could proceed to greater advantage without their presence.

McFadyen (39), in 1892, experimented on the amylolytic and proteolytic properties of (1) Koch's comma bacillus, (2) Deneke's cheese spirillum, (3) vibrio Metchnikoff, and (4) Finkler and Prior's spirillum. The experiments were carried on at 30° to 39° C. The following table indicates the results he obtained:

ACTION OF CULTURE ON STARCH PASTE.

ORGANISMS.	DAY.	NaOH.	IODINE.	FEHLING'S.
Koch's comma bacillus .	1	Faint yellow	Blue	Faint red
	2	Deep "	Viol.	Distinct red
	3	Orange "	Red	Cop. ppt.
	4	Orange "	Red	Cop. ppt.
Deneke's cheese spirillum .	1	O	Blue	O
	2	Faint Yellow	Blue	Faint red
	3	Yellow	Viol.	Distinct red
	4	Yellow	Red	Distinct red
Vibrio Metchnikoff . .	1	O	Blue	O
	2	Yellow	Blue	Distinct red
	3	Yellow	Viol.	Cop. ppt.
	4	Orange yellow	Red	Cop. ppt.
Finkler and Prior's spirillum	1	O	Blue	O
	2	O	Blue	O
	3	Faint yellow	Blue	O
	4	Faint yellow	Blue	Faint red

He also made a glycerine extract from each of these organisms, and allowed the extracts to act upon starch-paste, with the following results:

ORGANISMS.	DAY.	NaOH.	IODINE.	FEHLING'S.
Koch's comma bacillus .	1	O	Blue	O
	2	Faint yellow	Blue	Reduction
	3	Yellow	Viol.	Reduction
	4	Yellow	Red	Reduction
Deneke's cheese spirillum .	1	O	Blue	O
	2	Faint yellow	Viol.	O
	3	Yellow	Viol.	Reduction
	4	Yellow	Viol.	Reduction
Vibrio Metchnikoff . .	1	O	Blue	O
	2	Faint yellow	Viol.	O
	3	Yellow	Viol.	Reduction
	4	Yellow	Viol.	Reduction
Finkler and Prior's spirillum	1-4	O	O	O

From the results of these experiments he concluded that Koch's comma, Deneke's spirillum, and Metchnikoff's vibrio have amylolytic properties.

He also allowed forty per cent. glycerine extracts to act on gelatin, fibrin, and egg-albumin. He found that the action of these extracts caused the liquefaction of the gelatin and the disintegration of the last two substances. From this he concluded that the organisms experimented with have peptone-forming properties.

Gillespie (41), in 1893, while working with bacteria of stomach contents, added cultures of the organisms he isolated to a dialyzer containing proteid and pepsin ferment, acting in the presence of hydrochloric acid. After five hours' digestion, at 40° C., he examined the dialized fluid for leucin and tyrosin, and not finding these substances, he concluded that bacteria do not have any digestive properties. He also inferred from the results he obtained that the presence of bacteria in large quantities decreased appreciably the amount of albumin digested. He, however, gives no clear evidence for this last statement.

Nuttall and Thierfelder (40), in 1895, performed an interesting experiment upon guinea pigs. One of these animals was withdrawn from its mother, a short interval before term, by the Cæsarean operation, under antiseptic precautions, and was immediately transported into a sterilized bell-jar, which had previously been fitted up with sterilized bedding, on which to place the animal, and with two other devices, one for the reception of food and the other for the reception of the excreta. The food and air that got into the bell-jar were perfectly free from organisms. The guinea pig was kept under these sterile conditions for eight days. At the end of this period the animal was of normal size for its age, and weighed eighty-three grams. Another guinea pig of the same age and size, but kept under ordinary conditions, was found to weigh only eighty-two and one-half grams. Further observations, however, showed that at the end of the tenth day the weight of the sterile animal increased only about sixteen per cent., while in guinea pigs kept under normal conditions the increase in weight for the same time was between twenty and sixty per cent.

Two opposing inferences are at present drawn from the results of this experiment. One is that bacteria are not essential for the welfare of the young animal; the other is just the opposite of this, that bacteria are necessary for the normal development of the animal.

Hemmeter (1), in 1897, mentioned that some of the proteolytic bacteria are, baccillus subtilis, proteus vulgaris, bacillus putrifucus coli, and bacillus liquefaciens ilei. He, however, added that while the first products are albuminoses and peptones, the action of the bacteria upon the proteids is continuous, so that the final results are products of decomposition, and that the peptones formed are only the first stages of putrefaction, and do not serve any useful purpose in the economy.

Gillespie (41), in 1898, in a book written by him entitled, "The Natural History of Digestion," remarks as follows: "Some of the final products of aseptic tryptic digestion consist of the amido acids, tyrosin, leucin, and asparagin, and of the pigment tryptophan. Any of the bacteria are able to decompose the proteid molecules still further, although the first stages produced by their action are very similar to those produced by trypsin, *i. e.*, albuminoses and peptones are formed. Later on the amido acids, fatty acids, carbonic acids,

ammonia, amines, and, in some cases, indol and skatol, result from their activity."

In 1893, as was already seen, the same author concluded, as a result from his experiments, that bacteria do not form leucin and tyrosin. Upon what data he bases his present statement that "the first stages produced by the action of bacteria are very similar to those produced by trypsin," is unknown to me. His conclusion, however, that their final products are those of decomposition, is practically the same as advanced by Hemmeter in 1897. Both of these authors, however, do not give sufficient data upon which they base their belief that the first products of the action of bacteria are albuminoses and peptones.

Schottelius (42), in 1899, is reported by Duclaux to have performed an interesting experiment upon the chick. He began his manipulations with the eggs. One or two days before hatching he disinfected the shells with a five per cent. sublimate solution, he then washed them with a warm normal salt solution, and wiped them carefully with sterile wadding. The eggs were then placed in a double-walled sterile box, which was warmed by a fluid circulating between its walls. This box was in turn surrounded by a glass cage eight cubic meters in capacity—this case, also, having been previously disinfected. The air and food supplied to the chicks were entirely free from microrganisms. The results of the experiments with ten chicks showed that not only were the digestive tracts sterile, but that the entire bodies were so. This he proved to himself by placing a chick, entire, into a vessel containing sterile bouillon, and observed that no growth took place in the medium. By weighing these chicks at the end of twelve days he found that they increased only twenty-five per cent., and that from the twelfth day on, they decreased in weight gradually. In chicks hatched and kept under ordinary conditions, however, the weight at the end of twelve days showed an increase of one hundred and forty per cent., and that at the end of seventeen days their gain in weight amounted to two hundred and fifty per cent. He concluded from this experiment that the loss in weight in the case of sterile chicks, as compared to the weight in normal chicks, was due to the absence of bacteria in the former.

He also observed that the excreta from the sterile chicks for the first four to eight days, when poured upon gelatin, did not liquify that medium; while later excreta, taken from the same chicks, did liquify the gelatin. From these phenomena he concluded that the enzymes of the chick in the first few days of its existence have not yet fully developed their proteolytic properties, and that the chick, therefore, during that period, is in need of the help from the bacteria to perform the proteolytic functions in the alimentary canal. The inferences to be drawn from his conclusions, therefore, are that enteric bacteria have peptone-forming powers, and that their presence in the digestive tract is very essential to the young chick.

In the review just given it will be seen that in nearly every case where the investigator reached a negative or positive conclusion, the same was not based upon sufficient evidence to substantiate it.

Abelous reached a positive conclusion because he observed that the bacteria he experimented with could dissolve coagula of milk, egg albumen, gluten, and

fibrin, and produce acid and gas in saccharine media. The fact that bacteria can do all this is not sufficient proof that they can produce peptones.

McFadyen, Nencki and Sieber reached a negative conclusion, because they observed that bacteria did not produce putrefaction in the small intestine, and because they produced products of decomposition in culture media. All this, however, does not go to disprove their capability of producing peptones.

McFadyen brought to bear sufficient evidence to prove that Koch's comma bacillus, Deneke's cheese spirillum, and Metchnikoff's vibrio have amylolytic properties. But his conclusion cannot be accepted that those organisms have peptone-producing properties, because they or their products can liquefy gelatin and disintegrate egg-albumin and fibrin.

Gillespie reached a negative conclusion because he was unable to find leucin or tyrosin in the dialyzed fluid. The objection to this conclusion is obvious. It may be claimed for bacteria to have the power of producing peptones, though he was unable to find these substances under the conditions of his experiments.

The experiments of both Nuttall and Thierfelder and Schottelius go to prove that the presence of bacteria in the digestive tract is not absolutely essential for the maintenance of life in the young animal. But that the fact that the animals experimented with did not attain their normal development, goes neither to prove nor to disprove the capability of bacteria to produce peptones. The loss in weight in the sterile animals must be attributed to other unnatural conditions that were present in the experiments. No doubt the closeting in of the animals —the guinea pig in a bell-jar and the chicks in a triple-walled closed chamber, for twelve to seventeen days—had much to do with their abnormal development.

It is therefore evident that investigations up to the present time have not sufficiently established whether or not bacteria have peptone-producing powers.

The Microscopic Study of Metals.

In order to introduce this subject, which is somewhat recent in its development and not a matter of general knowledge, illustrations may be taken from the applications of the microscope to the work of the biologist and the physician.

The biologist employs the microscope in the examination of minute structural details. Not only the structural elements but their relations and groupings are the subjects of his investigations. In a restricted sense, a chemical analysis may afford some knowledge of the specimens; but this is not far-reaching and is rather a matter of secondary importance. One knows little of biological specimens from the knowledge of the chemical nature of their structural elements, the essential being rather the grouping of the structural elements. After the specimen is prepared for the microscope, differential chemical reagents may be applied to enable the structural elements to be distinguished; or, recourse may be had to the simpler process of staining. Then, as a further means of investigation, heat may be applied or mechanical means may be resorted to that the physical relations of the structural elements may be changed.

While to a certain extent the microscope may be employed by the physician

in an analogous manner, he usually employs it in a search for pathological, rather than bioglogical phenomena. He wishes to ascertain what structural changes have taken place in the tissues of the body as the result of disease or injury.

These familiar illustrations will lead directly to another field of microscopical technology, in which the specimens are metals and not organic tissues; and it may develop that these apparently dissimilar subjects have a very great deal in common, so far as the methods and even the ends sought are concerned. Until recently the applications of the metals to the arts and sciences, have been based almost wholly on the results of chemical analyses and certain physical tests involving, for instance, the limits of elasticity, and ultimate breaking strength.

Great efforts have been made to establish the physical properties of steel, for example, as a function of its chemical constitution, but, as one might readily infer, the success attending this has been only partial. Without desiring to be tedious, it may be well at this point to consider some of the demands the metallurgist is compelled to meet at the present time. It will no longer answer to use steel in framing a structure, and then more steel to make certain of it; efficiency requires that not a ton of metal above the amount actually required shall be used. Such conditions demand a complete knowledge of steels and other metals for structures, while the requirements of machinery are no less exacting.

In order to reduce friction in machinery, soft bearing metals are widely employed, which are usually an alloy of two or more soft metals such as tin and lead. This matter of friction is of such vital importance that it has become necessary to obtain a more complete knowledge of bearing materials than can be gained from their chemical analyses.

Chemical analysis can not take account of the physical treatment of metals in the processes of their manufacture. Drawing, rolling, hammering, and annealing, and other causes induce changes of structure which profoundly affect the elasticity and other physical properties, though they do not in the least change their chemical constitution. The results of impact and excessive strain can only be thoroughly known when the changes of structure which these causes have induced in the metals affected, are fully known. The investigation of such details corresponds closely with the search of the physician for pathological changes. The recent application of the microscope to the study of metals has proven so advantageous that it is probable that the microscope will become as necessary an instrument for those who apply the metals structurally or mechanically in an exact and scientific manner, as it now is for the practice of the physician.

There is frequently to be found in different specimens of wrought iron a failure to develop the degree of strength and elastic qualities which are to be expected from a metal of its chemical purity. By filing off a surface with the grain of the iron and etching it with HCl, the gross fibrous structure becomes apparent and layers of slag are to be made out; yet no precise information is to be gained from such a method. A more painstaking preparation of the surface, with greater care in the etching, will yield a specimen which may be subjected to a high power objective. Under its resolving power the crystalline structure can be seen and the exact manner in which the fine threads of slag interfere with the homogeneous fibre of the iron. The metallurgist in this way is enabled to see the faults in his

material and even to make quantitative estimates of the constituents presented to his view. In a general way this process may be applied to all metals, and places those who work with such materials in the possession of an exact knowledge of their intimate structure.

Fig. 1—× 30.
Sn, 75 per cent.; Sb, 20 per cent.; As, 5 per cent.

Fig. 2—Magnolia Metal.
Magnified 200 diameters. Pb, 80 per cent.; Sb, 15 per cent.; Sn, 5 per cent.

The influence of working on soft iron is easily traced by the aid of the microscope. When iron is compressed by traction through a steel drawplate, the original fibrous structure due to polygonal crystals is changed, especially on the outer layers, by the crystals becoming lenticular, as is readily seen under the microscope. If such iron is annealed its original ductility is usually restored; and it is an interesting question to determine by an examination, the extent to which the changes in the physical properties are functions of the changes in the structure. Specimens of soft steel which have shown the lenticular form of crystals after compression, upon annealing for two hours at 650° C. have been shown to have lost the lenticular shape of the granules; the crystals then being more or less equi-axial, resemble in this condition the crystals of ordinary iron.

Probably the more important results have been obtained from the study of alloys for their physical constitution; and the connection between this and their physical properties has always been involved in more or less obscurity in spite of a vast amount of investigation. The alloy of preëminent importance at present is steel, the variety of which both in structure and properties has been bewilderingly large. It is true that much has been learned about steel in the past, but the knowledge has been largely obtained through empirical methods. Chemical analysis has not been without great value, but wide physical variations in steel have been found to exist where there was practically no chemical variation which the processes of analysis at least were able to detect. With the development of the processes and methods of metallography, the metallurgist began for the first

time to acquire a somewhat exact knowledge of the steels; not only their true composition, but their physical properties as functions of their structure and composition. The technology of the subject of the metallography of steels is so extensive that it cannot be entered upon even in brief detail in such a limited article as the present one. Without enlarging upon the possible development of the metallurgy and physics of steels under the impetus of metallographic studies, it can yet be foreseen that we must eventually realize from them all the immense advantages that accrue from an exact knowledge of the structure and composition of these alloys and their physical properties as functions of these details.

Roberts-Austen more particularly has devoted himself to the study of the physics of the alloys of two and three metals, and his investigations are familiar to most physicists, and their value is generally appreciated. Later, Stead and Charpy[1] have added to the knowledge of alloys by their studies of the industrial alloys. From their work a bearing metal composed of tin, lead, and bismuth upon an examination of a section shows: (1) large areas of metallic bismuth with indications of grains of bismuth which have solidified between 175° and 125° C.; (2) around each grain of bismuth there existed a zone in which particles of bismuth alternated with particles of tin; (3) and this structure was held in a matrix of the eutectic mixture of the three metals.

The function of the bearing metals as a means for reducing friction and the wear of journals is very clearly defined from the micrographic study of their sections. The load of the journal is carried through them by the hard grains of the alloy, which have a low coefficient of friction, the plasticity of the matrix making it possible for the bearing to adjust itself closely around the shaft.

Two illustrations of micrographs of alloys, or metallographs * will suffice to give some definite conception of the work which has been done with alloys, though the structures in each case are coarser than are met with in the examination of the steels and need much lower magnifying powers for their resolution. The alloy shown in Fig. 1 is composed of tin, 75 per cent.; antimony, 20 per cent.; and arsenic, 5 per cent. The remarkable structure of this alloy is due in all probability to the arsenides of tin and antimony which have crystalized from a fusible matrix or eutectic. The circular sections of the crystalline structure indicate that these are in reality spherical masses embedded in the eutectic. The micrograph was made under the low magnification of 30 diameters.

A micrograph of Magnolia metal, a well-known anti-friction alloy, is shown in Fig. 2, it having been obtained with a magnification of 200 diameters. The composition of the alloy is: lead, 80 per cent.; antimony, 15 per cent.; and tin, 5 per cent. The foliated structure is due to the needle-like crystals of the compound of lead and tin which crystalized separately from the compound of antimony and tin existing in cubical crystals; both systems of crystals occur independently and exist side by side. The eutectic of Magnolia metal exhibits under high magnification a very beautiful structure apparently consisting of the crystallites of the cubical system, and are probably composed of the three metals.

From this general survey it must be apparent, to those not versed in the

[1] G. Charpy in Bulletin Société d'Encouragement pour l'Industrie Nationale, June, 1898.

* Nature, September 23, 1897, p. 506.

technology of metallurgy, that an adequate foundation exists upon which a new branch of science may be established, which must become of great value both to the pure physics of the structural constitution of metals and alloys, and especially to their applied physics. The new science rejoices in the name Metallography, a well-established term, which only questionably connects the numerous phases of the things it is supposed to designate. The development of the science is involved with the selection of the name for its designation. As formerly applied, metallography referred to a species of lithography in which etched metal plates replaced the stones of the other printing process. The earliest attempts at a study of the structure of metals were made by etching plates of iron or steel and obtaining some impression on paper from them. This process yielded merely a description of the gross anatomy of the specimens studied, and was of limited value. Presently, by an extension of the process of etching, specimens were obtained so finely grained they yielded only to the resolution of the high-power objective. Then metallographs became instead, micrographs. The recognition and extension of the micrographic process was the real beginning of the new science of the minute structure of metals, and has within the past ten years made wonderful progress. It is true that micrographs of metals had been made for many years prior to this recent advance, but no concerted investigation resulted. As the term metallography is now used, it denotes an increasing mass of knowledge obtained rather by the use of the microscope than methods dealing only with the gross anatomy of the metals. The practician of the new science is termed a metallographist.

THE PREPARATION OF THE SPECIMEN.—As in biological technology, the specimen must be cut down until the section desired for examination is reached. The area of the section is usually small, not exceeding one square centimeter.

The specimen bit of metal is first cut away by filing, sawing, a machine tool, or by grinding against an emery wheel, and it is then rubbed on emery cloth and paper of increasing degrees of fineness. Ultimately it is polished on leather with fine jeweler's rouge, or it may be buffed against a leather polishing wheel.

The specimens of the harder metals present few difficulties in their preparation and their surfaces polish readily. But many alloys are difficult to manipulate, especially when they contain lead or tin; these soft constituents are apt to spread or run over the surface of the specimen, making a film which will neither take a specular polish itself nor permit the process of polishing to extend to the harder constituents underneath. Emery paper can not be used on such metals, but their surfaces should rather be scraped plane.

If the constituents in the alloy are differently colored, polishing alone will be a sufficient process to enable them to be distinguished, but this is rarely the case; much less can the intimate structure of the harder metals be brought out by examining their polished surfaces. The microstructure is only developed by some etching treatment after a preliminary polishing. If the specimen is to be subjected to mechanical or thermal treatment in order to observe the structural changes thus brought about, the identical etching process must be employed throughout.

A specimen not to be subjected to further tests may be treated with differ-

entiating reagents and its various structural elements may in this manner be readily distinguished. The etching reagents commonly employed are acids, alkalies, and alkaline sulphides, when possible applied in dilute alcoholic solutions in order to remove grease left from the polishing process. That the etching may proceed uniformly over the entire surface it is necessary that this should be scrupulously cleaned. The cleansing calls for the exercise of considerable care and judgment, avoiding the use of any cleansing reagent which will produce the slightest etching effect. The specimen, too, after cleansing, must not be dried at a temperature which will cause oxidation of any structural constituent. It is scarcely necessary to add that the surface should not be touched with the finger at any stage in the cleansing or etching.

Electrolysis in a saline solution affords an additional and a rapid method of etching and is generally used, the specimen of course being connected with the positive pole of the battery. In case any of the constituents are readily oxidizable and show characteristically colored films under the treatment, the specimen may be slowly heated until the desired tint is obtained. This treatment is found to be useful in alloys containing antimony, lead, or copper. In the same line, differential coloring is often a ready means for the detection of certain constituents; tincture of iodine or any similarly acting reagent may be employed, the method being one which is capable of considerable extension and variation.

No especial form of microscope is needed for the work; any stand may be used which has preferably a large opening in the ocular axis of the stage. The stage, in short, should be of such design that specimens, often fragments of metal polished and etched on one side and of irregular shape, may be held in proper position for examination.

The lighting is a difficult feature and may be accomplished by the use of totally reflecting prisms, with or without condensing lenses. Doubtless the demands of this new branch will call out, from time to time, appropriate modifications in the microscopic stand and special auxiliary apparatus and attachments.

The new science has already in this country an excellent journal devoted specifically to its development, which was established in 1898. Its files will afford an accurate survey of what has already been accomplished and will give all the needed instruction for these interesting tests. It is called *The Metallographist*, and is edited by Albert Sauveur, who has been one of its foremost investigators.

WILBUR M. STINE.

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If sections drop out of the paraffin when cut, it is an indication that the tissue was not thoroughly dehydrated before embedding. The material should be run back through xylol into absolute alcohol and left until every trace of water is removed. If the specimen appears milky or opaque in the clearing fluid it is not ready for embedding, but needs to be left in alcohol for a longer time until dehydration is complete.

A Method of Preparing Small Marine Invertebrates for Microscopic Study.

While no method of fixation can properly replace the use of living material for study *in toto* of the minuter forms of marine life, it is nevertheless extremely convenient and important to preserve specimens already studied, types of new species, etc., in such a way as to retain as fully as possible the natural form, transparency and coloring, and at the same time have the specimen instantly accessible for re-examination. The writer has found the following method to meet all the requirements of the case for small Annelids and Echinoderms, and in all probability it will prove equally successful for a wide range of minute animal forms, excepting always those with impermeable chitinous integuments, like the Arthropods. *Syllidæ* and other small Polychetes up to a length of four or five centimeters have been successfully treated, and preparations made three years ago are as beautiful and instructive as at first.

The specimen is placed on a slide in a few drops of pure sea water, and slightly compressed with a cover-glass provided with wax feet. The compression can be quite accurately regulated by pressing down the wax feet at the corners of the cover-glass, or prying up the cover-glass a little at one or more corners with the point of a scalpel. If the specimen is a worm it will contract at first, but afterwards will usually become fairly extended. After two or three hours the worm, although still living, becomes almost perfectly quiescent. A few drops of a 4 per cent. solution of formaldehyde are then run under the cover-glass, its flow being hastened by drawing away with bibulous paper an equal quantity of water at the opposite side. The worm should die in a fairly extended condition. A sufficient quantity of formaldehyde should be run under to displace all the sea water.

After an hour or so the gradual replacement of the formaldehyde with glycerine may begin. The writer has always used undiluted glycerine, but for very delicate objects a mixture of equal parts of glycerine and water might be safer. The glycerine is applied in the same way as the formaldehyde, but more gradually—only two or three drops at a time. After the specimen has become completely surrounded and permeated with pure glycerine, the mount is sealed with Venice turpentine in the manner explained in Lee's "Vade Mecum," fourth edition, page 288. Preparations keep almost indefinitely without sealing, but with the obvious disadvantage that the glycerine is likely to flow over the slide in moist weather, and a mist gathers on the cover-glass.

The preparation should lie flat at all times. The method is not so time-consuming if a number of preparations are made at one time.

University of California, Berkeley, Cal. HERBERT PARLIN JOHNSON.

Syracuse University receives $25,000 by the will of the late Erastus F. Holden of Syracuse.

MICRO-CHEMICAL ANALYSIS.

III.

APPARATUS.

Slides.—The slides employed in micro-chemical testing must be of thin glass, and as resistant as possible to the action of solvents. It is a great misfortune that the colorless glass slips in use in America and so excellent for ordinary microscopical work should be easily attacked by all liquids; even water extracts a relatively enormous amount of alkalies and alkaline earths. The slips of greenish glass, while not as neat nor desirable for general microscopy, seem to be decidedly more resistant, and are therefore preferable. It is greatly to be desired that some enterprising firm place on the market slips of resistant glass. In the absence of any such material one must be content to employ that at hand; it being then necessary to avoid long contact of strong acid or alkaline liquids with the slides, and to have recourse to platinum ware if heating for any considerable time is called for.

Standard 3 x 1 slips are too long; half slips will be found more convenient for rotating on the stage, moreover micro-chemical reactions are generally performed at the corner, seldom, if ever, in the center of the slide, and these corners soon become attacked through frequent use. The slip must then be discarded. Half slips are, therefore, more economical.

On account of the rapid deterioration of ordinary slides, those with unground edges will generally be chosen from the standpoint of economy. When permanent preparations are to be made and kept for future reference, preference will naturally be given to slides with ground edges.

It is possible to greatly prolong the life of a slide by cleaning it immediately after completing a test or a series of tests.

Objectives of low power being employed, cover-glasses are almost never used, the drop being examined just as it is. On very rare occasions a case may arise where a cover-glass will be of great assistance.

When working with hydrofluoric acid and its derivatives, varnished slides have been generally employed. These are tedious and sometimes difficult to prepare and annoying to use, in that they cannot be warmed to hasten evaporation. A far better plan is to be provided with a few pieces of thin, transparent celluloid, cut the size of slides.* Celluloid as clear and as nearly colorless as possible should be chosen. A few trials of these slides will convince the most skeptical of their convenience and utility. They are, of course, never as clear and transparent as glass slides coated with a varnish of Canada balsam, and cannot, therefore, replace the latter for very fine work. Thinner, more transparent celluloid may be made into tiny boxes, and inverted over drops giving off acid fumes to protect objectives. It is true that their imperfect transparency is a drawback, yet on the whole they are fairly satisfactory.

* I believe the use of celluloid slides for hydrofluoric acid work to be original with Prof. Behrens, although I am not aware that their use has been suggested in any of his numerous articles. (Since this manuscript was written a new edition of Behrens's "Anleitung" has appeared in which attention is called to the use of celluloid slips.)

Platinum Foil.—A piece of reasonably stiff foil 2 to 3 cm. wide by 3 to 4 cm. long will be found of continual use. It must be kept flat, and its surface maintained bright and smooth. Its uses are manifold: testing purity of reagent; treatment of samples with substances attacking glass; heating material at temperatures above that supported by glass slides, etc.

Platinum Cups.—Two sizes are conveniently employed: one, 20 mm. in diameter and 2 mm. deep (see Fig. 4); the other smaller, 10 mm. in diameter and about 3 mm. deep. These little cups are easily and rapidly prepared from a piece of the foil mentioned above, by stamping it on a block of lead with a steel die. These cups must be kept clean and bright. If distorted in scouring, restamping repairs them at once. They are used for fusions, evaporations, decomposing substances with strong acids or alkalies, etc.

Fig. 4.
Full Size.

Platinum-tipped Forceps.—Steel forceps with rather heavy platinum tips (Fig. 5) may be said to be practically essential. Of course, any forceps provided with platinum points can be employed, but preference is to be given the form

Fig. 5.—Half Size.

illustrated. In the absence of such an instrument, fine dissecting forceps will be called for. A sliding ring of metal foil on the forceps will be found useful in maintaining a tight grip on platinum foil or cups, and will prevent the fingers from becoming cramped.

Platinum Spatula.—The end of a platinum wire, 1 mm. in diameter, is hammered out flat on a polished steel surface until it becomes a little over 3 mm. wide. The flattened space should be about 10 mm. long. The blade is then shaped with a file and polished. A handle 80 mm. long is ample (Fig. 6). This tiny spatula will probably be employed more than any other piece of apparatus.

Platinum Wires.—Fifteen mm. lengths of ½ mm. platinum wire are carefully fused into the ends of pieces of small glass tubing about 70 mm. long. These wires are employed for adding reagents to test drops, and for stirring. Longer pieces of platinum wire will be kept in reserve to be used in bead tests when the occasion demands.

Glass Rods.—For most purposes glass rods drawn out at one end (Fig. 7) will be found a little more convenient than the platinum wires described above. These rods cannot, of course, be employed when dealing with hydrofluoric acid, its derivatives, or strong alkalies, nor can they be heated as can the platinum wire. Aside from these cases they will be found well adapted for applying reagents, and stirring. If the large end of the rod is somewhat flattened or "upset," and then carefully

Fig. 6.
Full Size.

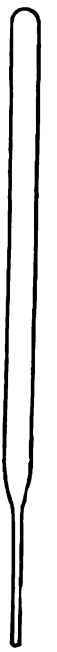


Fig. 7.
Full Size.

Fig 8.
Full Size.

ground smooth and slightly rounded with a file, an efficient little pestle will be produced, which is useful for crushing particles of reagents or materials to be examined. A convenient size of rod is 4 mm. diameter and 80 mm. long. The end should be drawn down to about 1 mm.

Pipettes.—Although the addition of reagents, either solid or liquid, is generally performed by glass rods or platinum wires, it not infrequently happens that a larger volume of liquid is required than can be applied or removed by this means. To meet such contingencies small pipettes (Fig. 8) are valuable. A glass tube of 2.5 to 3 mm. internal diameter drawn down to a bore of rather less than 1 mm. answers every purpose.

Fig. 9.
Full Size.

Filtering Tube.—All ordinary filtration methods are useless in dealing with the minute amounts of liquids employed in micro-chemical testing. The most satisfactory method with which the writer is familiar consists in employing the filtering tube of Prof. Behrens (Fig. 9). This consists of a glass tube 70 to 80 mm. long, 2 mm. internal diameter, and with walls not less than 1 mm. thick (1.5 mm. is better). One end of this tube has its edges rounded by holding it for an instant in the flame of a Bunsen burner, the other end is ground perfectly square and true so that it can fit tightly against a flat surface. The methods of micro-filtration will be given later.

Watch Glasses.—A supply of small watch-glasses 20 mm. and 25 mm. in diameter will be found desirable. Deep watch-glasses are better than flat, shallow ones.

Blow Pipe.—A blow pipe is employed for the production of high temperatures. It is the blast lamp of the micro-chemical laboratory. The instrument used in blow pipe analysis, provided with a platinum tip, is the best form, but an ordinary jeweler's blow pipe will do.

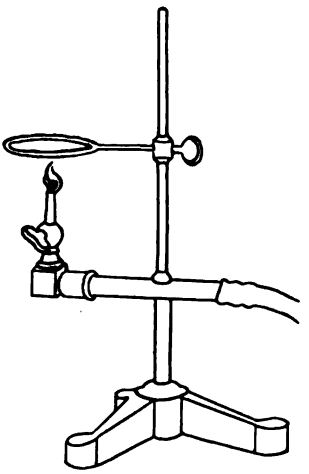


Fig. 10. × ½.

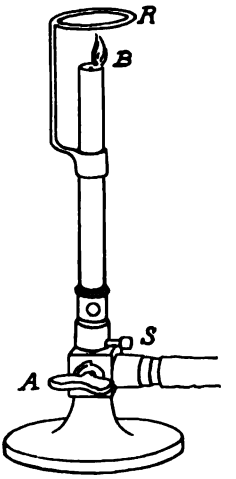


Fig. 11. × ½.

Agate Mortar.—For crushing samples, mixing material for fusion, etc., nothing can equal the agate mortar. Its size will be appropriate to the rest of the pigmy laboratory outfit, namely, in the neighborhood of 35 mm. outside diameter.

Gas Lamp.—Two forms of burners are in use: one, the so-called micro-chemical burner (Fig. 10), is useful, but not capable of giving a moderately high temperature without employing a blow pipe. The other (Fig. 11) is far more serviceable and convenient. This latter is an ordinary Bunsen burner provided with side tube (or reserve flame). In this form the tiny flame for micro-work is furnished by a small tube inside the regular burner tube; this flame is always burning when the gas is turned on from the gas main. Turning the stop cock *A* lights the Bunsen burner. The size of the small flame *B* should be regulated by the set screw *S* to a height of 3 to 4 mm. If, as often happens, this flame cannot be lowered to the proper size, remove the screw *S*, insert a tiny wedge-shaped fragment of lead, point first, replace the screw and tighten till the flame is lowered to the proper size. The burner is not supplied with the supporting ring *R* shown in the figure, but this attachment can be made in a few minutes by fastening a bent copper wire to a split brass ring which can be raised or lowered, and maintains its position through friction. A heavier ring with thumb screw would undoubtedly be better, but this latter arrangement is not so simple.

Filter Paper.—A supply of good filter paper is indispensable; for use with the filtering tube a thick, soft paper is desirable, for example, No. 598 of Schleicher & Schuell.

If much micro-chemical work is to be done and a wide field covered, then a supply of the ordinary utensils of the chemical laboratory is necessary, e. g., beakers, funnels, test tubes, evaporators and the like. This is particularly true of organic micro-chemical analysis. Although complete inorganic qualitative analyses can be performed with the apparatus described above, it will be found convenient to have apparatus capable of dealing with larger amounts of material.

Centrifugal Machine.—No laboratory can be considered as complete if not supplied with an efficient centrifuge. Occasions are not lacking when such an instrument can be utilized with advantage. In selecting a machine, special attention should be paid to its solidity, speed, noiselessness and ease of running. It is also desirable that it be as compact as is consistent with efficiency.

Cornell University. E. M. CHAMOT.

When preparing worms, spinal cords, and other specimens that exist chiefly in one dimension of space, there is frequent difficulty in keeping them straight, either on account of muscular contraction, or because the tissue is not rigid enough to overcome the buoyancy of the preserving fluid. In all such cases a small weight tied to the end of the specimen will keep it in position.

LABORATORY PHOTOGRAPHY.

Devoted to methods and apparatus for converting an object into an illustration.

A NEW APPARATUS FOR INSTANTANEOUS PHOTO-MICROGRAPHY.

The subject of photo-micrography is alike interesting to students of both biological and physical science. It involves not only accurate and interesting work with microscopic organisms, but from the physical side, which includes the photographic, much care is required in the selection and manipulation of the proper microscopical lenses in connection with the source of light employed, the stain, if a mounted slide, used upon the subject to be photographed, and the chemistry necessarily connected with the handling of the photographic plate itself in order to obtain the best results.

The different general methods employed in this work, together with proper magnification for certain forms, the kind of illuminant, ray filters, exposure, and character of plate require separate treatment, as the chief object of this article is to describe a new apparatus for making instantaneous photographs of living microscopic animals.

After having worked upon photo-micrography for some time for the purpose of obtaining photographs of microscopical slides for illustration with the optical lantern, and having determined the conditions requisite to the production of good results with mounted slides, the thought occurred to the writer that if an instantaneous photograph of a living organism could be made it might be valuable to the biologist.

It will at once be apparent to those who have worked along this line that a powerful light is necessary for instantaneous work; in my own work with the apparatus an arc light consuming 2200 watts is employed which gives, in the position used, about 4000 candle power. This light, as will be seen from the picture of

Arrangement of Camera, Microscope, and Lamp, for Instantaneous Photo-Micrography. Viewing Screen and Shutter show at top of Microscope.

the apparatus entire, is placed at a distance a little greater than the focal length of a condensing lens, so that the intensity of light upon the object and objective is considerably greater than would be the case without the lens. Of course, a different position of the lens and light would greatly magnify the intensity of the light, but that is undesirable beyond a certain limit, as the heat would be detrimental to the microscope objective.

With proper arrangement of the light the essential feature in making the instantaneous photographs shown herewith is the combination shutter and view tube, which is made to be clamped by means of three thumbscrews to the draw tube of the microscope. This apparatus is fastened on after the ocular has been inserted in the draw tube. The mechanism of the apparatus is as follows:

Upon a movable brass plate inside a light-tight box (shown just below the camera bellows), is a 90° prism mounted in such a way that all of

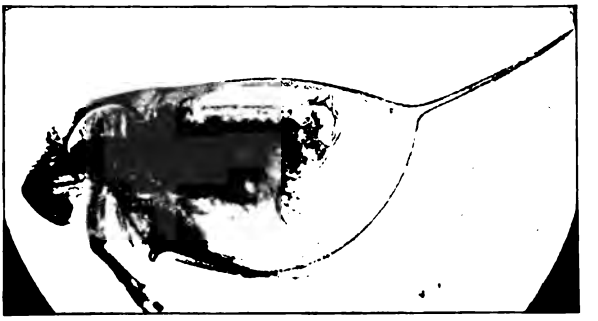
Snap Shot of Living Daphina (reduced from 150 diameters).

Snap Shot of Living Ostracod (reduced from 200 diameters).

the light which passes through the microscope is projected upon a piece of ground glass at the end of a cone which may be lengthened or shortened in order to give correct focus to the object, when it is properly focused upon the ground glass of the camera directly above the microscope. Next to the prism is a hole in the brass plate for allowing light to pass from the microscope directly to the photographic plate, when the prism is moved by means of a spring and pneumatic release, and finally a sufficient area of the brass plate to cover the opening when exposure has been made.

To take a photograph, the microscopic animal is placed in a drop of water upon a suitable glass plate, the light is turned on and the shutter so set that the object may be focused upon the ground glass of the cone. The plate-holder is inserted and the dark slide drawn, leaving the plate exposed inside the camera bellows. The movements of the animals are easily seen upon the ground glass, and when the desired position is obtained the shutter is released, the prism moves out of the way, and the light passes to the plate. Cramer's Isochromatic

plates have given the best satisfaction with this instantaneous work. Although the apparatus is not perfected to the writer's complete satisfaction, exposures as short as $\frac{1}{40}$ of a second have been very satisfactory. None of the negatives whose prints are shown with this article had more than $\frac{1}{25}$ of a second exposure. It seems perfectly possible, with good microscope objectives and the best arrangement of illuminant, to obtain thoroughly satisfactory negatives in $\frac{1}{100}$ of a second, when used with low-power objective.



Snap Shot of Living Daphina (reduced from 150 diameters).

The apparatus may be of some value other than photographic to biologists from the fact that it allows one to study the movements of a living microscopic organism with both eyes with perfect ease instead of by the common one-eye method, which is apt to be tiresome.

A. C. SCOTT.
Rhode Island College of Agricultural and Mechanical Arts.

A Differential Stain for Cell Structures.

Preparations stained in several colors are not always the best to show details of structure. For ordinary class work, however, sections which bring out the various cell organs in distinct colors are very convenient, and to a large extent preclude misinterpretations. The writer has some slides, prepared a number of years ago, which are not only fantastic in color, but show details of structure very well. The method by which these slides were prepared was lost and forgotten for several years; but having been re-discovered, it is recommended to those who have beginners at work on the subject of karyokinesis in plant cells. It will be found best for ordinary root tips, and the material must be killed in chrom-acetic acid to bring out the proper color effects.

Stain first for two or three hours in anilin safranin, according to the formula given on page 258, Vol. II, JOURNAL OF APPLIED MICROSCOPY; next stain for about 30 minutes in an aqueous solution of picro-nigrosin. The picro-nigrosin must be made in the following proportions:

Distilled water,	100 cc.
Picric acid,	1 gram.
Nigrosin,	1 gram.

First dissolve the picric acid completely in the water, and then add the nigrosin. After staining, dehydrate and mount in balsam.

The stain is permanent, and if the operation is successful the result will be as follows: cell-wall, well stained and black; cytoplasm of a bluish color; spindle threads and cytoplasmic radiations, bright green; chromatin network and chromosomes, brick red; nucleoli, bright red; thickened connecting fibers of the central barrel-shaped spindle, dark green and very distinct; granules of the cell plate, black.

A set of slides stained in this way will not only go far in giving a clear idea of the structures concerned in cell division, but will also show very distinctly the diverse character of the various constituents of the cell.

Botanical Laboratory, Ohio State University. JOHN H. SCHAFFNER.

Journal of Applied Microscopy.

L. B. ELLIOTT, EDITOR.

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LONDON, ENG.

Editor of the JOURNAL OF APPLIED MICROSCOPY, *Rochester, N. Y.:*

Dear Sir—I enclose a paper which you may see your way to use in the JOURNAL. I have found the method such an improvement over those that I have tried, that I believe it would be of use to such of your readers as are working in the same lines, and as I have to acknowledge the benefit I have derived from your paper, thought I might in my turn help others in what is a somewhat awkward operation as at present performed.

Yours truly,

The sentiment of the above letter expresses our ideas in regard to the principle upon which the JOURNAL was founded and has been conducted, and the spirit in which contributions to it could be made. The fact that, comparatively, but little attention has been paid to the recording of microscopical methods, from the standpoint of the technicist, has doubtless been responsible to a considerable extent for the non-development of the habit of recording carefully the technique of the operations involved in the demonstration of a given subject, where results, not methods, are the essential feature. While most investigators give an outline of the methods pursued by them in reports of important observations, a great deal which would be of value is omitted, and others working for different results upon the same kind of material lose valuable experience which might, with little trouble, have been given to them, and are obliged to work out the problems anew. It is with the hope of inducing more observers to make careful records of the minor details of the methods employed by them, and the special apparatus devised for carrying out their work, that we again call attention to the desirability of the publication of such records. The JOURNAL offers an unusually favorable medium for the publication of such material, on account of its wide circulation among teachers of sciences requiring the use of the microscope, and among those engaged in the industries in which the microscope has come to be a helpful factor. It only remains for those who are giving their time and efforts to the furthering of these sciences to take advantage of the opportunity offered to make what would otherwise be an unprofitable part of their work, of great value both to science and to the industries upon which science depends for its support.

* * *

We thank our readers for their kind forbearance during the delay in the publication of the JOURNAL. The numbers will now be speedily brought up to date.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to
Charles J. Chamberlain, University of Chicago,
Chicago, Ill.

REVIEWS.

Stevens, F. L. The Compound Oosphere of Albugo bliti. Bot. Gaz., 28: 149–176, 225–245, pl. 11–15, 1899.

The term, compound oosphere, is a new one. The author defines it as an oosphere containing several or many functional sexual nuclei. The development of the oogonium and antheridium, the details of oogenesis and spermatogenesis and the process of fertilization are thoroughly studied and described. The author's summary is about as follows: The oogonium, when cut off from the parent hypha, contains about 300 nuclei which enlarge and divide mitotically while the oosphere is being differentiated. The oosphere is differentiated through a massing of the cytoplasm of the oogonium. By this process nuclei are expelled from the central region and there results a dense and coarsely vacuolate periplasm. This condition occurs when the antheridial tube is very short. There is a stage called zonation in which the nuclei, usually in the metaphase, are lined up around the ooplasm, some of the spindles lying across the definite boundary which separates the ooplasm from the periplasm. At the end of this mitosis about fifty nuclei are formed in the ooplasm.

The antheridium contains at first about thirty-five nuclei which divide twice simultaneously with the division in the oogonium and oosphere. Previous to the entrance of the antheridial tube a papilla projects from the oogonium into the antheridium.

The antheridial tube penetrates slowly, reaching the ooplasm at the time of zonation, later entering the oosphere and appearing as a conspicuously multinucleate structure. It discharges about one hundred male nuclei which fuse with the female nuclei in pairs. The sperm nuclei are elongated, while those of the egg are spherical.

A peculiar central body, the coenocentrum, develops within the oosphere as the oosphere matures and disappears before fertilization. It may be a dynamic center for the compound oosphere.

In the mitoses, which are alike in the oogonium and antheridium, the spindles and centrosomes are intranuclear.

The oospore after its complete encasement by the spore walls, becomes filled with foodstuffs. The fusion nuclei pass the winter in the resting condition.

The paper is fully illustrated by excellent plates which show clearly the actual appearance of the sections and add weight to the author's conclusions.

Albugo (more widely known as *Cystopus*) is rather abundant on *Amarantus retroplexus*. Chromo-acetic acid (0.8 per cent. chromic, 0.5 per cent. acetic in water) proved best for fixing. Flemming's triple stain gave the best results. Sections were cut 3 to 5 μ in thickness. C. J. C.

Balicka-Iwanowska, Gabrielle. Contribution a l'etude du sac embryonnaire chez certain Gamopetales. Flora 86: 47-71, 8 plates, 1899.

The author, working under the direction of Professor Goebel at Munich, without endeavoring to add anything "essential in a domain where extensive researches" have already been made, takes up the question of the nutrition of the embryo-sac in a number of gamopetals, and in the course of this study she is "able to establish certain facts of detail which are not without importance." The forms chiefly studied were those belonging to the Scrophulariaceæ, to which were added representatives of Gesneraceæ, Pedalinaceæ, Plantaginaceæ, Campanulaceæ, and Dipsaceæ.

The most striking detail presented is the morphological adaptation for securing nutrition at both micropylar and chalazal ends of the sac; it is noteworthy that while in the Rubiaceæ, close toxonomical neighbors of these families, the micropylar morphological structure for securing nuttition is the suspensor and the chalazal structure is a modification of the antipodal, in the forms under consideration, neither suspensor nor antipodal is important, and the haustoria, as the specialized conductors are called, originate from the endosperm with occasional assistance from the nucellus; they do not result, even, as modifications of the synergids.

These haustoria are developed in connection with a thick integument; attain the greatest development sometimes at the micropylar, sometimes at the chalazal end; are of all forms from the simplest to the most complex, and lay tribute, in different cases, to tissue in every position from the proximity of the embryo-sac itself to the the remotest portion of the integument, even reaching the funiculus and placenta. Morphologically they are often like latex tubes and their accompanying nuclei seem to have the power of direction toward the best nutrition. Their variations, however, are so numerous that they afford no basis for classification although their presence in a number of families shows close relationship.

Nearly every sac is lined to a greater or less extent with tapetal cells which are digestive rather than protective in function; in case these cells are cutinized the sac is apt to contain starch, otherwise not.

The paper deals with the subject from a physiological standpoint and is entirely occupied with interpretations which this view would give, or with the discussion of new details. The plates show such remarkable developments in some of our neglected neighbors, such as the Plantagos, that the author's contribution should add several important and extremely interesting details to our knowledge of the general morphology of "certain Gamopetals."

Chicago. JOHN E. WEBB.

Goff, E. S. The Origin and Early Development of the Flowers in the Cherry, Plum, Apple, and Pear. Sixteenth Ann. Rep. of the Wis. Agric. Exp. Sta., pp. 289-303, figs. 55-77, 1899.

Little or no work has been done along this line by practical horticulturists. Mr. Goff was fortunate in securing quite complete series in the four forms mentioned and his results should prove to be of considerable importance. He finds that in well stained microtome sections the young flowers which are to produce the next year's fruit can be distinguished quite early in the summer, the rudiments of the flowers being recognizable in the apple as early as June 30th,

in the plum June 8th, in the cherry July 11th, and in the pear July 21st. In all these forms the calyx, corolla, stamens, and carpels are easily recognized before the winter sets in.

While the investigations do not throw any light upon the primary cause of the formation of flowers, they at least show clearly when the flowers are formed and consequently show when those causes are acting which determine whether a bud is to be vegetative or reproductive. The writer remarks that the environment of our fruit trees during early summer may be quite as potent in determining what the fruit crop of the following year is to be, as that during late summer.

C. J. C.

Pirotta, R., and Buscalioni, L. Sulla presenza di elementi vascolari multinucleati nelle Dioscoreacee. Annuario del R. Instituto Bot. di Roma, 7: 237–254, pl. 10–13, 1898.

This paper deals with nuclear phenomena in the large cells which form the vessels of the vascular bundle. The history is traced from the earliest period at which the row of cells which is to develop into a vessel can be distinguished, up to the time when the transverse walls disappear and thus convert the row of cells into a continuous vessel. As the cells of the row enlarge, but before the transverse walls disappear, the nucleus divides repeatedly. In many of the cases figured the division is simultaneous, the nuclei being in about the same stage of mitosis as is usually the case in pollen-mother-cells. In other cases the division is amitotic. While some of the figures show familiar forms of amitosis, others show that the nucleus has divided repeatedly so as to give rise to a chain of nuclei which has a moniliform appearance like the nucleus of *Stentor*.

Toward the close of the period of nuclear division, when the cells may contain more than a hundred nuclei, the enormous lengthening of the cell takes place and soon the transverse walls disappear.

C. J. C.

Harper, R. A. Nuclear Phenomena in Certain Stages in the Development of the Smuts. Trans. of the Wis. Acad. of Sciences, Arts, and Letters, 12: 475–498, pl. 8–9, 1899.

For a study of the germinating spores and conidia cultures were made in beerwort on the slide or in watch crystals. The author's method of making preparations from this material is ingenious and will undoubtedly prove valuable in making preparations of various small plant and animal forms. A drop of the material is taken up with a capillary tube and is then gently blown out into a drop of Flemming's weaker solution (fifteen minutes or an hour was sufficient for the fungus spores). Cover a slide with albumen fixative as if for sections. A drop of the fixed material, without previous washing, is drawn up into the capillary tube and touched lightly and quickly to the surface of the albumen. A series of such drops, almost as small as the stippled dots in a drawing, may be applied to the slide. The fixing agent may now be allowed to evaporate somewhat, but the preparation must not be allowed to dry. As the slide is passed rapidly through the alcohols the albumen is coagulated and the preparation may be treated just as if one were dealing with ribbons of sections.

Since there are still some who either deny the existence of nuclei in the fungi or regard their structure as simpler than that of the nuclei of higher plants, it is interesting to note that this method shows in the smuts a nucleus with nuclear

membrane, nucleolus and chromatin network. The nucleus divides by karyokinesis, showing well defined chromosomes and achromatic figure.

In *Ustilago scabiosa* a promycelium pushes out from the spore before any nuclear division has occurred. The nucleus of the spore now wanders into the promycelium and undergoes two divisions, so that four nuclei lie free in the promycelium. Three transverse walls now appear and from each of the cells conidia are budded off. Several other cases of spore germination are described.

The latter part of the paper is devoted to cell fusions in which no nuclear fusions occur. C. J. C.

Wager, Harold. The Sexuality of Fungi. Ann. Bot. **13**: 575–597, 1899.

This paper presents a comprehensive review of the present knowledge regarding sexuality among the fungi. Some Phycomycetes are known to be truly sexual (*Peronospora*, *Albugo*, *Polyphagus*, the Mucorales, and *Basidiobolus*). Among the higher fungi two types of nuclear fusion are known. One consists in a union of an antheridial with an oogonial nucleus (Sphærotheca). The other is a fusion of separate nuclei of one cell, an oscus, a basidium, or the like, preceding spore formation. (*Sphærotheca*, *Peziza*, the Basidiomycetes, Urdinales, and Ustilaginales.) The difficulty is to interpret these two types of nuclear fusion, both of which may occur in the same plant. The first is evidently homologous with the true sexual act in the Phycomycetes. Wager suggests that it is possible that as the first fusion is not followed immediately by spore formation, the second nuclear fusion may be needed to reënergize the nucleus, and that the fungi which exhibit the second type of fusion only may have degenerated from forms which had both types, such as *Sphærotheca*.

This solution of the perplexing question is simple and beautiful. A further accumulation of facts must pronounce upon its tenability.

Chicago. F. L. STEVENS.

Campbell, D. H. A Peculiar Embryo-sac in Perperomia pellucida. Ann. Bot. **13**: 626, 1899.

After the second divison of the nucleus of the macrospore the four nuclei are arranged at equal distances from each other much as in tetrad division in spore-mother-cells. After the next nuclear division the eight nuclei are arranged equally about the periphery of the sac without any suggestion of polarity or any sign of differentiation into egg apparatus, antipodals and polar nuclei. Still another division takes place and the resulting sixteen nuclei are equally distributed about the periphery of the sac. Whether more than sixteen nuclei are present before fertilization is not yet determined, but the author says it is easy to show by unbroken series that sixteen nuclei are present before fertilization. He has not yet determined the origin of the ovum. C. J. C.

Fry, Rt. Hon. Sir Edward, D. C. L., LL. D., F. R. S., F. L. S., and Agnes Fry. The Mycetozoa and Some Questions which they Suggest. Pp. viii+82, London, 1899.

This little book is one of the well known "Knowledge Series." It is an attempt to introduce to the acquaintance of readers less scientific the group of organisms named in the title. We cannot regard the effort as especially successful. The attempt to popularize by using throughout the name "Myxie" is

unfortunate, even though that word does "rhyme with pixie." Science may not be so demeaned. The book contains many illustrations, several from Lister's Mycetozoa; these are not improved by the transfer. The poor lay-brother, for whom slime mould is a name too hard, which must forsooth be diluted to myxie, will from the illustrations form, we fear, only the vaguest idea of the objects Sir Edward bids him understand; and the text, while probably truthful, will surely bring little enthusiasm, to say nothing of knowledge, to one otherwise uninstructed in things pertaining to the Mycetozoa. Science cannot be taught in this way, and we are surprised that Agnes Fry did not bring her woman's tact to correct in some measure the heaviness of her much-titled collaborateur.

University of Iowa. THOMAS H. MACBRIDE.

CYTOLOGY, EMBRYOLOGY, AND MICROSCOPICAL METHODS.

AGNES M. CLAYPOLE.

Separates of papers and books on animal biology should be sent for review to
Agnes M. Claypole, Sage College,
Ithaca, N. Y.

CURRENT LITERATURE.

Gurwitsch, A. Zur Entwickelung der Flimmerzellen. Anat. Anz., 17: 49–58, 1900.

Through the researches of Lenhossék and Henneguy, much light has been thrown on the structure of ciliated cells and the possibility of the origin of the basal bodies from the centrosome advanced. This suggestion has been well and widely received, but has not yet been demonstrated, no embryological studies having been made. The author does not consider his work complete as yet, but has found some interesting points that are presented in this preliminary notice. The materials used were ciliated epithelial cells from salamander larvæ, mouth epithelium, and the choroid membrane, since embryological material of molluscs is difficult to obtain. The comparative investigation of the development of both kinds of cells disclosed so many significant differences in process, that comparison with other objects is most desirable, especially in reference to the fibrillar cone, which is entirely lacking in salamander cells. In the earliest stages of the development of the mouth epithelium in cells still possessing numerous yolk granules, there appears on the outer surface a more or less distinct border, entirely homogenous and quite strongly refractive, measuring about two microns in breadth. The next clearly marked change is the appearance of a honeycomb structure. The cells are prismatic, very regular in contour, and arranged in a single row on the surface of the cell. This is followed by a stage in which the cells of the honeycomb become arranged in several rows, the whole thickness of the border equaling the length of the cilia. The plasma structure of these cuticular cells was obscured by two things; first, the large size of the nucleus and relatively small cell body, and second, the very numerous and fully distended mucous cells appear to press in the cuticular cells lying

between them. The centrosome cannot be seen except during mitosis, at other times it is concealed by the large nucleus. The cuticle next becomes strongly striated, the surface appears as if formed of a somewhat coarse net covered with fine points or spots. The cilia still embedded in a matrix take the usual pale gray color in iron-hæmatoxylin, and the thin membrane between is red. At this stage the cilia are practically complete, and as yet no signs have appeared of the basal bodies, these well known structures are entirely absent. This absence was equally evident in living cells, which were isolated from tissues containing fully developed cells with motile cilia. The immobility of the latter might depend upon the absence of the basal bodies or upon the presence of the cement, which could not be definitely determined. This, then demonstrated that the origin of the cilium is, according to these researches, completely independent of the centrosome, since after the striations have appeared on the free borders of the cells, mitotic divisions occur in which the centrosome is definitely seen. Furthermore the author does not find any cone of fibrillæ, and hence this is not an indispensable adjunct of such a cell. The possible later division of the centrosome and its application to the fibers of the cilia is rejected as too difficult a process to occur, and hence the more probable changes are a development of the basal parts of the cilia themselves by a differentiation and thickening of their substance. From his studies the author can deduce no constant type of development, but rather finds great diversity, as would be likely in cells of very different function. In spite of certain appearances in endyma cells where the cilia are more scattered and the basal bodies larger, the interpretation of independent formations of these bodies is urged as avoiding the difficulties of the centrosome theory. In any case, whether the cilia arise in numbers with a membrane as in the case of the mouth epithelium, or whether they arise singly and freely as in endyma cells, the process of independent origin will apply.

A. M. C.

Sargent, P. E. Reisner's Fibers in the Canalis Centralis of Vertebrates. Anat. Anz., **17**: 33–44, 1900.

The author first noticed a rod-like structure in sagittal sections of the spinal cord of the trout (*Salvelinus fontinalis*). This rod had a uniform diameter throughout and took stains sharply, and could be traced continuously from the widening of the fourth ventricle to the end of the canal. Its presence was demonstrated in all Teleosts examined, and the author believes it to be present in all vertebrates. Hitherto it has been believed to be an artifact due to the coagulation of fluids in the canal, and hence not considered an organic structure. The author was impressed by the consistency of its appearance with all kinds of fixing reagents, and searched for it in tissues hardened in liquids well known for their clearness of fixation as well as those that precipitate freely. In cross sections of the spinal cord, Reissner's fiber is usually found lying near the center of the canal; it is inconspicuous, usually 2μ or less in diameter, and often further obscured by the presence around it of corpuscles and loose cells. Such sections show in *Cynoscion*, when stained with Erlich's hæmatoxylin and Congo red, a very definite internal structure. A medullary portion takes the Congo red evenly and is found to have a finely granular structure. Surrounding that is a hyaline layer which takes the stain very slightly

if at all. Outside this on the periphery is a sheath taking a deep hæmatoxylin stain. Normally the fiber has a perfectly straight course through the canalis centralis, but occasionally it may have an undulating course as if it had been under tension with a sudden release. At intervals fine fibrillæ are seen coming off and running outward to the periphery of the canalis centralis. This condition is seen most clearly in the posterior region, and the constant diminution in size of fiber toward the posterior end is probably due to this branching. In a few cases these branches were seen to penetrate between the epithelial cells lining the canal. Anterior to the central canal the fiber passes into the fourth ventricle and runs through the aqueduct of Silvius into the third ventricle; in the ventricle of the optic lobes, the fiber continues to the torus longitudinalis which projects ventrad and caudad from the anterior wall of this ventricle. There is some amount of branching before entering the torus. Between the time of sending the paper to press and its appearance, an article appeared by Studnicka, "Der Reissnerische Faden an dem Centralkanal der Rückmarkes und sein Verhalten im Ventriculus Terminalis." Sitzengsbr. böhm Gesellsch. Wiss. Math. Naturen. Cl., July, 1899. This author concludes from his studies, principally on Petronyzon, that the fiber is a secretion not at in any sense nervous. In a later paper Sargent means to give further facts and prove its truly nervous nature.

A. M. C.

Munson, J. The Ovarian Egg of Limulus. A Contribution to the Problem of the Centrosome and Yolk-Nucleus. Jour. of Morph. **15**: 111–220, 1898.

The author collected his material at Woods Holl and also in Long Island Sound off New Haven. The best killing reagents were found to be Kleinenberg's picro-sulphuric, corrosive acetic and a mixture of equal parts of 10 per cent. solution of nitric acid and picro-sulphuric. The last named fixer was excellent, and especially for tissue to be stained in Lyon's blue and lithium carmine. Merkel's fluid gave the best results for karyokinetic figures. Smaller eggs were cut and embedded in paraffin, larger ones in collodion. Staining on the slide was used almost exclusively. The larger eggs cut in collodion were stained with Delafield's hæmatoxylin, diluted ten times with water and acidulated with HCl. This leaves yolk spheres unstained. Heidenhain's iron hæmatoxylin followed by erythrosin, eosin, or acid fuchsin, was used for mitotic figures. Erythrosin and cyanin proved useful and especially lithium carmine and Lyon's blue. Material killed in Merkel's fluid and stained with Erlich's hæmatoxylin and acid fuchsin gave on the whole the most reliable results. The ovarian egg was studied with special reference to the nucleolus and the yolk-nucleus. Some of the results of work on the former can be briefly summed up as follows: The nucleolus appears first when the egg first grows, and early assumes a spherical form, but is differentiated into an outer and inner parts. The central part stains intensely with iron-hæmatoxylin, and the outer red with eosin; later the central part often elongates and protrudes through the outer zone, to be finally extruded. A succession of these bodies may be so formed and are the so-called "Neben-nucleoli." In the living egg they appear as spores resembling yolk, but as they arise long before any yolk is formed they are clearly differentiated. After the extrusion of the central mass the nucleolus may remain crescentic,

or may appear as if a hollow sphere filled with a homogenous liquid or a linin net-work with granules scattered through it. These granules may be taken for vacuoles, but stain deeply in iron-hæmatoxylin. The nucleolus may be formed of different constituents, linin framework, substance resembling chromatin and substance resembling yolk globules. The entire structure disappears when the ova are shed from the follicles, so its history is coincident with the period dur- which the egg has an organic connection with the parent.

The centrosome persists in the cytoplasm after the last division of the oogonia to form a follicle. At early stages it consists of two concentric circles of microsomes with a central granule which are all imbedded in a more or less amorphous substance, archoplasm. The whole structure taken together is called the "vitelline body," and clearly does not rise from the cytoplasm of the growing egg nor as a bud of the germinal vesicle, nor as extruded chromatin, nor as migrating nucleoli; it contains no nuclear chromatin. It is genetically the centrosome and sphere of the dividing oögonia and forms the centrosome and attraction sphere of the developing egg. In conclusion the author states that the attraction sphere, centrosome and vitelline body are the primitive basis or center of growth of the cytoplasm. A. M. C.

Schneider, Albert, M. D., Ph. D. Microscopy and Micro-technique. 8vo, pp. 189. Chicago, 1899.

The immense strides which the science of microscopy has taken during recent years has brought forth many papers on microscopical methods and kindred subjects, as well as several entire volumes dealing with the same topics. We now have before us another new book by Dr. Schneider, Professor of Botany, pharmatography and materia-medica at Northwestern University School of Pharmacy.

The treatment of the subject is divided into two parts, of which part one deals with microscopy, while part two is devoted to micro-technique. Under part one we find six chapters dealing successively with the history of the microscope; the history of the manufacture of glass; the reflection of light by mirrors; refraction of light by various bodies; the intensity of light; the simple microscope and its properties; the compound microscope; important accessories, including micrometers, camera lucida, photo-micrographic apparatus (termed by the author micro-photographic), and test objects; aberration, aperture, focal and working distance, penetrative power, resolving power, and magnifying power; manipulation of the instrument; how to use the eyes; care of the instrument, and hints on the purchase of a microscope.

In part two, under three chapters, are discussed the materials used in the work, including desks, tables, chairs, microtomes and knives; glass-slides, cover-glasses, turn-tables, etc.; reagents arranged in alphabetical order, and also according to their properties; temporary mounts; permanent mounts, including the collodion and paraffin methods; special methods, and general directions. Following part two, we find twenty-two pages devoted to a discussion of the normal and abnormal eye; dealing with the optical properties, defective sight and care of the eyes.

At the present time, owing to the increased specialization in the laboratory work of the different colleges and high-schools, so that each teacher has his own

particular methods and scope of work, it is almost impossible to prepare a text-book which shall meet the requirements of more than a few persons at one time. The classes whose requirements are most adequately met are those of the author himself, and on this account it is difficult to give a wholly impartial criticism of the scope and arrangement of such a book.

The present work, according to the preface, has been designed for the use of students in schools and colleges where the microscope is employed in biological study. Such a work, we think, should be of one of two kinds,—either a class-book to be used by the students continuously, or a reference book to be used only occasionally by both student and teacher. The former should be arranged properly for class room use, and be not overburdened with detail, while the latter should obviously be comprehensive. Of these two types the work in hand must be classed with the first, but here it noticeably falls short in two of the essential properties of a class-book, namely, definiteness of statement and clearness of the definitions (e. g., those on aberration and aperture).

The arrangement and choice of material is on the whole good, although perhaps some chapters, namely those on the history of glass and on the eye, are not absolutely essential in a book like this. To us it would seem as though the extensive use of mathematics in part one is somewhat beyond the comprehension of the average student of the microscope, or even of many college students, and moreover is scarcely necessary in such a work On the other hand, the chapter on reagents is much too brief. It seems doubtful whether, to the average student, this chapter would be of much actual value. Fewer reagents treated with more extended accounts of those discussed might have improved this feature of the work. Is not alcannin used as often in the study of oils as for resins; and is it wise to wash material fixed in picric acid with water? Most authors recommend washing in alcohol, since water tends to deteriorate such material. In view of the excellent accounts of the history of the microscope in Carpenter, Hogg, and other works on the microscope, and of the entire volume devoted to that subject by Canton and Petri, one feels a little surprised to find on page 4 of the present work the statement that "there seems to be no comprehensive historical record of the invention and evolution of the microscope, simple and compound."

The author's style also is not above criticism. We might wish to see fewer statements as to the great inferiority and lack of comprehensive power of the average student as compared with the instructor (e. g., p. 41, ¶ 2; p. 53, ¶ 1; p. 67, ¶ 1); and in a few places sufficient care has not been used in the previous explanation of terms and passages employed (e. g., "virtual," p. 37). Whether a collector of insects should be termed scientifically a "bug-hunter" (p. 43) might also be questioned.

The work is illustrated by ninety-five zinc cuts, most of which are reproduced from the publications of the Bausch & Lomb Optical Co., and of the Leitz Optical Co., and are in the main of good quality.

The historical chapters are interestingly written, and those dealing with methods are perhaps the best and most accurate in the whole work. The addition of the chapter on the normal and abnormal eye is a novelty in such a work, and one which all users of the microscope should understand. The book

is in many ways an interesting addition to the literature of microscopy, and will doubtless find a place on the work-table of many users of the microscope.

K. M. WIEGAND.

Murbach, L. Hydroids from Woods Holl, Mass. *Hypolytus peregrinus*, a new Unattached Marine Hydroid, Coregnitis, Agassizii, and its Medusa.

These new specimens were found while dredging for larvæ of Gonionemus in an eel pond at Woods Holl, and it was at first supposed to be a larval form, but finding some bearing gonophores the following summer it was proved to be an adult form. It peculiar interest lies in the fact that it is one of very few forms freely movable in the adult condition. These polyps, are found temporarily attached by a secretion to some object several feet below the the surface, or else floating on the surface. The color is pink, pale or bright, and mostly in the endoderm cells of the body. The regions of the body are well marked into a hydranth, leaving two circlets of tentacles and the gonophores, and a hydrocaulus. In size the adult varies from 1 to 1½ cm. long and 1 to 1½ cm. thick. A large number of nettling organs are present on the lower edge of a ring-like expansion or collar where the hydranth joins the hydrocaulus. The whole hydrocaulus is covered from collar to foot by a delicate perisarcal envelope, to which adheres many foreign objects. This can be lost and quickly replaced. The sexes are distinct and the ova and spermatozoa mature in gonophores placed above the aboral set of tentacles. These are mature by the middle of August. Asexual reproduction takes place by a curious process of constriction. The foot end is separated and resembles a large planula of Pennaria; later it becomes attached by its narrow end and develops into a young Hypolytus. The polyp is thus seen to be single unbranched, of the Tubularian type, with a circlet of tentacles. A primitive perisarc envelops the hydrocaulus from which heads are given off, while sexual reproduction also exists.

A. M. C.

CURRENT BACTERIOLOGICAL LITERATURE.

H. H. WAITE,
University of Michigan.

Separates of papers and books on bacteriology should be sent for review to H. H. Waite, 709 North University avenue, Ann Arbor, Michigan.

Celli, A. Ueber Immunität gegen Malariainfektion. Centrlblt. f. Bakt., **27**: 107–110, 1900.

In this investigation Celli used the blood serum of malarial patients and serum from animals infected with large amounts of blood taken from malarial patients. The milk and fluids expressed from the spleen, bone marrow, lymph glands, pancreas and brain gave negative results, with the exception that milk possibly showed a slight delay in the period of incubation and a very mild fever in the infected individual. Quinine, potassium bromide, potassium iodide, arsenic, phenol (subcutaneously), antipyrin, phenokol, methylen blue and euquinine were also used. The author draws the

following conclusions: 1. Some persons possess a congenital immunity against malarial infection, both in regions where malaria is epidemic and against experimental malaria. Others acquire immunity through a previous attack of the disease. 2. The cause of this immunity cannot be explained on the ground of serum therapy, since neither toxin nor antitoxin is found in these infections. 3. Neither through the disease products of malaria in other animals, nor through blood serum, organic fluids of immunized animals, nor through the juices from mosquitos free from or containing the malarial parasite, can artificial immunity be produced, but only through powerful doses of euquinine or methylen blue.

H. H. W.

Babcock, S. M., Russell, H. L., Vivian, A., and Hastings, E. G. The action of Proteolytic Ferments on Milk with Special Reference to Galactase, the Cheese-ripening Enzyme. Sixteenth Ann. Rep. of the Agri. Exp. Stat. of the University of Wisconsin, pp. 157–174, 1899.

A comparative study of the action on milk proteins of various unorganized ferments, including trypsin, pancreatin, pepsin, rennin, and galactase (a ferment discovered in milk by Drs. Babcock and Russell), and of a number of organized ferments, including *Bacillus subtilis* and other digestive bacteria, was made by the above authors. It is shown that galactase, while related to the tryptic type of ferment, as regards conditions of reaction, differs quite decidedly from it in the character of the products of digestion, chiefly in the formation of ammonia. In this and other ways, the action of galactase resembles that of liquifying bacteria. The close agreement between the character of the products of digestion of milk by galactase and the proteins of a well-digested cheddar cheese is pointed out.

VICTOR BASSETT.

Bullock, W. A Simple Apparatus for obtaining Plate Cultures or Surface Growths of Obligative Anærobes. Centrlblt. f. Bakt., **27**: 140–142, 1900.

The principle of this method is a combination of displacement and absorption. Inasmuch as it is practically impossible to completely displace all the air by hydrogen or coal gas, failure to obtain good growth of the obligative anærobes frequently results. To overcome this difficulty displacement is first resorted to with the subsequent absorption of the remaining traces of oxygen by alkaline pyrogallic acid. (Cut pp. 141. Centrlblt. f. Bakt., Bd. **27**.)

The apparatus consists of a belljar with a ground glass lower edge which fits a similar ground glass slab. At the upper end of the belljar are two ground glass stoppers which are perforated, the one by a long, the other by a short glass tube. Above, the tubes are bent and fitted with glass stop-cocks. The lower edge of the belljar is smeared with unguentum resinæ (B. P.). A deep Petri dish is placed on the slab and in this are placed pyrogallic acid, 2 to 4 grams dry, away from the long tubule which nearly reaches the bottom of the Petri dish, and a beaker containing the inoculated tubes. Plates might be used in a similar way by resting them on a beaker or some other support. Air is displaced by passing hydrogen or coal gas into the apparatus, causing it to enter the short and emerge from the long tube. After displacement both stop-cocks are closed. Since the bell jar is now filled with an indifferent gas, it is necessary to produce a partial vacuum before the potassium hydrate solution can be introduced. The

short tube is connected with an air-pump, and a partial vacuum formed after opening the stop-cock, which is again closed. To the long glass tube is attached a piece of rubber tubing which dips into a vessel containing a strong potash solution. The stop-cock is opened and the potash solution run in. The stop-cock should be closed and the rubber tube placed in a vessel which contains water before running in all the potash solution, in order to remove the potash from the ground glass stopper on which it has a corrosive action. The stop-cock is now closed and cultures placed in the incubator. This method is especially applicable for cultivation of the obligative anærobes, which grow but poorly, or not at all, when any free oxygen is present. In this way cultures can be made in the Novy bottle, or in the apparatus devised for the growth of plate cultures of the anærobes. The latter require less manipulation and have the advantage of being less expensive than the apparatus used by the author. H. H. W.

Alfred Vivian. A Comparison of Reagents for Milk Proteids, with some notes on the Kjeldahl Method for Nitrogen Determinations. Sixteenth Ann. Rep. of the Agri. Exp. Stat. of the University of Rochester, pp. 179–186, 1899.

The author has compared the quantitative reactions of various reagents for the analysis of proteins as applied to cheese extract and digested milks. Of these reagents a series was selected and a method of analysis planned which serves to show the extent of ripening of cheese or of the action of ferments on milk and on proteins. Insoluble protein (casein albumin) was precipitated by acetic acid and by boiling. Albumoses are differentiated by zinc sulphate, peptones by phosphotungstic acid and tannic acid, and ammonia determined by distillation with magnesium oxide. The nitrogen was determined in the filtrates by the Kjeldahl method and the amount of nitrogen in the precipitated protein secured by differences. The distribution of nitrogen in a cheddar cheese six months old, thus determined, was as follows :

Insoluble portion,	3.18	per cent.
Albumoses,	0.06	"
Peptones ppt. by tannin,	0.16	"
Peptones ppt. by phosphotungstic acid,	0.13	"
Amides,	0.86	"
Ammonia,	0.09	"

This method of analysis has been used in the chemical and bacteriological work of the Wisconsin Agricultural Experiment Station, and will doubtless be of use to physiological chemists, bacteriologists, and others who require a rapid and fairly accurate method for the analysis of proteins.

This article closes with some notes on the Kjeldahl method as applied to cheese and milk. VICTOR BASSETT.

NORMAL AND PATHOLOGICAL HISTOLOGY.

RICHARD M. PEARCE, M. D.

Harvard Medical School, Boston, Mass., to whom all books and papers on these subjects should be sent for review.

Dunham, Edward K., Professor of General Pathology, Bacteriology, and Hygiene in the University and Bellevue Hospital Medical College, New York. Histology, Normal and Morbid, 448 pages, 363 engravings. Lea Brothers & Co., New York and Philadelphia, 1898. Cloth, $3.25 net.

This volume is divided into three parts, Normal Histology, Morbid Histology, and Histological Technique.

In the portion (263 pages) devoted to the first part of his subject the author aims to give the student in a condensed form an outline of the structure of normal tissues and to place before him at the same time the normal activities of these structures.

A brief description of the ovum and the differentiation of the germ layers is contained in the introduction. This is followed by an account of the structure and physiology of the cell The phenomena of karyokinesis are described briefly but clearly.

In the following chapters the normal structure of the various tissues and organs is described in a condensed but lucid manner. The relation between structure and function is frequently considered.

It is evident, from the space which is given to certain points which are usually difficult for the student to understand, that the writer in preparing this work has kept his class-room experiences constantly in mind. As an example of this are the diagrams illustrating the appearances of the nuclei and protoplasm of smooth muscle fibres when cut in different planes.

In such a condensed work, naturally some descriptions appear meagre. Thus, in the description of the lung no mention is made of the lymphatics beneath the pleura. The elastic tissue of the arteries is described as though the same in all arteries of equal size, whereas recent investigations show that it varies not only in amount but also in arrangement in different arteries of the same size.

Throughout, the writer clings to the older terminology. This hardly seems justifiable in a book for students, in view of the present agitation in favor of improvement in nomenclature. In an attempt to correct a very common error the writer illustrates the difficulty of dropping completely old familiar terms. In describing the lymphatic system he very properly insists on the use of the term "lymph node" instead of "lymph gland"; but in all other portions of the book these structures are called "lymph glands." Nor does the inconsistency cease here, for the small aggregations of cells within the lymph node, which to be uniform should be called "lymph nodules," are referred to by the older but improper term "lymph follicles." These are no more follicles (follicle meaning a small sac or cavity) than the entire mass is a gland.

The portion devoted to Morbid Histology covers one hundred and thirty pages. Abnormal cell changes are taken up under the following heads:

Degenerations and Infiltrations, Atrophy, Hypertrophy and Hyperplasia, Metaplasia, Structural Changes Due to and Following Damage, and Tumors.

These subjects have been dealt with in a very general way, as a result of which many important points are described very briefly, or not at all. For example, under hyaline degeneration, no mention is made of the frequent hyaline change in the epithelium of the kidney in acute infectious diseases. Again, in distinguishing between croupous and diphtheritic membranes, the anatomical basis for the difference is not pointed out.

It is surprising not to find "cloudy swelling," the older and more classical term, mentioned as a synonym for parenchymetous degeneration; and under phagocytosis to find no mention of this phenomenon in connection with endothelial cells.

In discussing tuberculosis the proliferative and exudative lesions due to the tubercle bacillus are not clearly differentiated. The most typical examples of proliferation, the lesions caused by the typhoid bacillus, are not mentioned.

The chapter devoted to tumors is very adequate and well illustrated. Accompanying the description of new growths in the breast is an interesting series of cuts representing the microscopic appearance of this gland at different ages and at different stages of activity.

In the third portion, fifty-one pages, devoted to histological technique, the more important methods are briefly described. Two pages are devoted to the use and care of the microscope.

To the student who desires a general knowledge of normal and pathological histology this work is of considerable value; but it is to be hoped that in the next edition, the treatment of morbid histology will be amplified, and more space given to special pathology.

The illustrations are abundant and as a rule well chosen. The original drawings are not as clear as those taken from other works.

The work of the publisher has been well done. R. M. P.

Abramow. Ueber die Veränderungen der Blutgefässe bei der Syphilis. Zeigler's Beiträge, **26**: 202, 1899.

The work was based on two cases in one of which a positive history was not obtained.

The lesions were confined mainly to the arteries of the extremities and the internal organs; the vessels of the central nervous system were but slightly affected.

The conclusions arrived at are as follows: 1. All coats may suffer independently, the intima by proliferation of its endothelium, the adventitia by cellular infiltration, the media by granular degeneration.

2. When intima and adventitia are both affected, they may unite by compressing and obliterating the media.

No new elastic tissue is found, the loss of substance in the wall being filled by connective tissue. This may readily predispose to aneurism formation.

3. In some cases the proliferative process in the intima ceases. The membrana fenestrata then becomes very thick, and finally splits up into many elastic fibres, which penetrate the newly formed tissue of the intima.

4. The only form of arteritis which can specifically be called syphilitic is that in which gummatous new formations are present. A. M.

Joannovics, G. Ueber das Vörkommen, die Bedeutung und Herkunft der Unna schen Plasmazellen bei verschiedener pathologischen Processen. Zeitschr. f. Keilk. **20**: 159, 1899.

For the study of plasma cells Joannovics recommends that the tissues be hardened in alcohols of increasing strength. Formalin also gives good results. Absolute alcohol shrinks the tissues. Muller's fluid, Formol-Muller, and Zenker's fluid interferes with the action of the stains.

For staining, the following modification of Unna's method is preferred:

1. Polychrome-methylene blue 20 to 30 minutes.
2. Thorough washing in water 24 hours.
3. Glycerine and ether mixture until color cloud appears.
4. Decolorize and dehydrate in 95 per cent. alcohol, and finally in absolute alcohol.
5. Clear in origanum oil, followed by xylol.

Great weight is laid on thorough washing for 24 hours. R. M. P.

NEUROLOGICAL LITERATURE.

Literature for Review should be sent to JOURNAL OF APPLIED MICROSCOPY, Rochester, N. Y.

Langdon, Fanny E. The Sense-organs of Nereis Virens, Sars. Jour. Comp. Neur., **10**: 1–77, pls. 1–3, 1900.

Diffuse sense-organs, spiral organs, paired cephalic organs, and epidermal anchoring cells are described. The diffuse sense-organs, which probably serve for the perception of mechanical and chemical stimuli, are definite groups of bipolar nerve cells whose distal processes extend to the surface through canals belonging to the sense-organ. They lie entirely in the epidermis. Proximad, their processes form pericellular nerve-baskets around the ganglion cells of the central nervous system. The only previous accounts of similar nerve-baskets in worms are those given by Retzusi and Simon for the leeches.

The spiral organs are groups of about one hundred bi- or multipolar unpigmented cells, whose peripheral processes are arranged spirally around a central tube formed apparently of invaginated cuticula. The bodies of the cells lie in the base of the epidermis, or in special pouches that project from its base.

The peripheral processes are club-shaped, and at the tip of each one is a hardened refractive body, the terminal halves of which are arranged to form a spiral band around the central tube. Structurally they suggest compound glands, phosphorescent organs, or ocular organs, but from a close study of them it was decided that their function is to distinguish varying intensities of light. The spiral structure is explained as the result of the increase in depth of the epidermis, and the sinking of the cellular bodies of the spiral organs below their former level.

The anchoring cells are modified epidermal cells, from both poles of which fine processes pass to the cuticula. They appear to serve for anchoring muscles to the cuticula.

Müller's fluid was used for killing. The nerve elements were stained by injecting the worms with 1½ per cent. Ehrlich's methylen blue in normal salt solution. The stain is affected by the circulation of the worm; when that was vigorous the cells were well stained, if not, they were only slightly affected.

The best results followed the injection of a small amount of fluid, and then injecting more after a short time. Exposure to air seemed to make little difference, and specimens placed in the dark gave the best results.

Tissues were kept on the ice in Bethe's fixing fluid for from 4 to 6 hours, and dehydrated in ice-cold alcohol. Tissues that faded out when embedded were found to have been imperfectly dehydrated. Cold xylol was used for clearing, tissues were kept in paraffin 2 or 3 hours, and the paraffin changed before embedding.

Sections were cut from 20 μ to 45 μ thick, and fixed to the slide with albumen fixative. After three years sections showed no sign of bleaching. The cuticula was somewhat difficult to remove, the best results being obtained after killing in 10 per cent. salt solution and leaving for a few days in this fluid, then washing in distilled water and placing in 35 per cent. alcohol, then slit the worms and remove the cuticle.

Kreidl, Dr. Alois. Ueber den Ursprung der Hemmungsnerven des Herzens bei Fischen. Arch. f. Physiol., **77**: 196–201, 1899.

The writer attempted to locate the nerve fibers inhibiting the action of the heart in *Scyllium canicala*, *Mustelus lævis*, *Raja quadeimaculata*, and *Torpedo marmorata* by opening the skull and stimulating the nerve stems in the *foramen jugulare*, where the numerous root fibers from which the Vagus is made up have united. Inhibitation of the heart followed stimulation of either the right or the left Vagus. The next experiments were made upon the root fibers that extend out fan-like from the medulla oblongata to determine still further the location of the inhibiting fibrils, and for this purpose he exposed the whole nerve bundle. By testing the Vagus accessorius root region he found that the bundles lying nearest the cerebrum have no influence on the heart, the only effect produced being a motor effect on the gills when a strong current was used. The fibers are hard to count, but as well as he could determine, about the fifth or sixth nerve root from the distal end of the bundle has the inhibiting fibrils. Stimulation of the portion of the medulla oblongata lying at the level of the exit of the Vagus stops the heart beat. This region lies near and caudad to another place where stimulation produces contraction of the gill muscles. Apparently the inhibiting fibers originate in the caudad portion of the Vagus-accessorius root region.

In mammals the inhibiting nerves have a similar position, and phylogenetically the root fibers leave the medulla at the same level. The relations in amphibia, reptiles and birds remain to be studied.

In reviewing the literature of the subject he finds that previous contradictions regarding the location of these fibrils was due to different ideas as to the limits and relations of the Vagus and accessorius regions. E. M. B.

Journal of Applied Microscopy.

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MICRO-CHEMICAL ANALYSIS.

IV.

REAGENTS FOR INORGANIC QUALITATIVE ANALYSIS.

In all cases only the very purest chemicals should be obtained. The quantity employed is so very small that there is no need of trying to be economical by purchasing commercial chemicals. A few grams of almost any reagent can be made to last a lifetime.

In preparing the list given below, it has been thought advisable to divide the reagents into two groups: 1. *Those which are essential or frequently employed.* 2. *Those infrequently used, or serving in special and unusual cases.*

To facilitate the making out of sets of reagents and lists for purchasing material, an alphabetical arrangement has been followed, and immediately after each reagent (save in the case of the common acids and alkalies) a list has been appended, of the elements with which that substance forms crystalline deposits or other reactions which are suitable for micro-chemical examinations. This list will be found useful for reference when performing an analysis.

Reagents of undoubted value have been omitted, but many of these are inconvenient or the results difficult of interpretation, and in all such cases it is believed that better results can be obtained by the reagents given.

I.—REAGENTS FREQUENTLY EMPLOYED.

Acids.—Fully concentrated acids as well as dilute will be found useful. Concentrated acids must be kept in the laboratory hood, and all operations requiring their use must also be performed in a hood with a good draft. Moderately dilute acids only should find a place on the work tables.

If the vials in the portable case of Behrens (described below) are to be filled, it is generally desirable to employ for this purpose a stronger acid than that mentioned for table use. A convenient strength for this purpose is about one part strong acid to one part distilled water. The distilled water should be freshly prepared from time to time, since that kept in bottles soon acts on the glass, and also takes up material from the air.

Acetic Acid.—Pure glacial acid should be employed.

Hydrochloric Acid.—Dilute 1 part conc. c. p. acid (sp. gr. 1.2) with 3 to 4 parts water. The strong acid, unless quite recently drawn from a carboy or large stock bottle of hard glass, is apt to contain a relatively large amount of

material dissolved out of the bottle. The ordinary glass stoppered bottles of American manufacture are generally of soft glass, and are readily attacked by liquids. In spite of all precautions the dropping bottles and tube vials must be emptied from time to time, otherwise the solutions in them will be found to contain sodium, potassium, calcium, traces iron and manganese, etc. Ammonia is taken up from the air by acids.

Hydrofluoric Acid.—A frequently recommended and undoubtedly valuable reagent, but difficult to keep properly and dangerous to handle. The ammonium salt—*ammonium fluoride*—is preferable. It is kept in the solid state in ebonite or cerosine tubes (or paraffine lined vials if nothing better is obtainable). Unless the salt is known to be perfectly pure, fractional sublimation must be resorted to, and only the middle fractions employed after testing them for the presence of silicon, the alkalies, etc.

Hydrofluosilicic Acid, or better and more serviceable *Ammonium Fluosilicate.*—Although the reactions given by this reagent are not as sensitive nor as conveniently obtained as some other reactions for the same elements, requiring as they do specially prepared slides or celluloid slips, the fact that neat and more or less characteristic tests can be obtained for a number of elements warrants its being given a place among the important reagents. Hydrofluosilicic acid can be used for detecting: *Na, K, Li; Sr, Ba, Mg; Mn, Fe.*

Nitric Acid.—One part concentrated acid (sp. gr. 1.4) to four parts of water. The concentrated acid employed should be free from all yellow color. If exposure to light has given rise to the formation of lower oxides of nitrogen, remove them by blowing air through the liquid. Renew the acid in dropping bottles from time to time. The remarks made under hydrochloric acid concerning impurities dissolved, apply here also.

Oxalic Acid.—The dry c. p. crystallized acid is finely powdered and employed in the solid condition. It is well to remember that even so-called c. p. material is very apt to contain notable amounts of Na, K, and Ca, and that the commercial article is very impure. Reactions are given by this substance with *(Gl), Ca, Sr, Ba; (Mg), Zn, Cd, Tl; rare earths; Sn, Pb; U, Mn; Fe, Ni, Co, Cu, Ag, Pd.*

Sulphuric Acid.—Concentrated c. p. acid (sp. gr. 1.8) is useful for decomposing minerals and for hastening crystallization by desiccation. Micro-desiccators are made by placing a tiny drop of concentrated acid in a watch-glass and spreading out this drop so as to make a very thin layer; thus prepared, the watch-glass is inverted over the drop in which crystallization is to be hastened, or the slide is inverted over the watch glass. Dilute acid for general use is made by adding one volume of concentrated acid to 8 or 10 volumes of water.

Commercial acid is very impure. Chief among the impurities are lead and ammonium sulphates, as well as material extracted from bottles.

REAGENTS EMPLOYED IN SOLUTION.

Ammonium Hydroxide.—Pure, stronger ammonia, U. S. P. Cannot be kept for any length of time in ordinary reagent bottles. Refill frequently. Dropping bottles and vials containing ammonia water must be kept at a distance from

acids. Used in neutralizing and precipitating; in detecting *Mg*, *Phosphoric* and *Arsenic acids*.

Ammonium Sulphocyanate.—Saturated solution. A valuable reagent giving some of the most interesting and elegant reactions of micro-chemistry. Used alone or in combination with other salts serves for detecting *Zn*, *Cd*, *Hg*, *Pb*; *Mo*; *Co*, *Cu*, *Ru*, *Pd*, *Au*.

Magnesium Acetate.—Saturated solution. Used in testing for *Na*, NH_3, *Phosphoric*, *Arsenic acids*, etc. In its place solid *magnesium sulphate* may serve.

Platinum Chloride (more properly *chlor-platinic acid*).—Should be free from free nitric and hydrochloric acids. A solution is made of the strength generally employed in analytical laboratories, i. e., equivalent to 1 g. Pt. in 10 cc. solution. Affords valuable reactions for NH_3, (*Na*), *K*, *Rb*, *Cs*; *Gl*, *Tl*. Test the solution from time to time by evaporating. The residue should contain no octahedral crystals, and if it is to be used for detecting sodium, this residue must show no crystals of sodium chlorplatinate.

Platinum Sulphate.—A moderately dilute solution serves for detecting the *halogens*. This can be satisfactorily prepared by heating in a platinum cup a little platinum chloride with a slight excess of sulphuric acid. Repeat the treatment several times. The reaction is complete when a portion treated with a trace of potassium sulphate fails to give octahedral crystals ($K_2 PtCl_6$).

SOLID REAGENTS.

Ammonium Acetate.—Used to remove excess of strong acids which might interfere with various reactions. Sodium acetate can be employed as a substitute, but is less satisfactory.

Ammonium Carbonate.—Employed both for precipitating and for dissolving compounds formed by other reagents. As a precipitant for *Li*, *Ca*, (*Sr*), *Ba*; as a solvent in testing for *Gl*, some of the *rare earths*, *U*.

Ammonium Chloride.—Enters into a number of reactions; is of particular value in searching for *Mg* and *V*.

Ammonium Dichromate, or if not at hand *Potassium dichromate.*—Gives crystalline compounds, which can be utilized for micro-chemical testing, with the following elements: *Ag*; *Sr*, *Ba*; *Hg*, *Tl*, *Pb*.

Ammonium Fluoride.—See *Hydrofluoric acid.*

Ammonium Fluosilicate.—See *Hydrofluosilicic acid.*

Ammonium Molybdate.—Must be tested for the presence of phosphorus and silicon, both of which this salt is apt to contain. Treat a small portion with nitric acid, evaporate on a slide; the residue must be white and contain no yellow crystalline grains. Heavy metals, unless present in excess, will not seriously interfere with its use. Employed for *P* and *Si*.

Barium Acetate, or in its place *Barium chloride* or *nitrate.*—Serves as a reagent for *Si*, *W*, *F*.

Calcium Acetate (*Calcium chloride or nitrate*).—The most convenient reagent for *sulphuric* and *arsenic acids*. Less useful for *tungsten*.

Cesium Chloride.—Is best employed as the solid salt in the form of very small crystals or powdered. Owing to its deliquescent nature it frequently

happens that only a saturated solution is available. This will answer equally well, but is not so conveniently handled. Reagent for *Al* and *Sn*, used also in testing for *Sb*, *Bi*; *S* (*Se*), *Te*; *Ru*, *Os*.

Copper Acetate (or *crystallized copper sulphate*) in fine powder. Valuable in confirming presence of *Zn*, *Hg*, *Pb*, *Pt*.

Lead Acetate.—The normal acetate in fine powder. Employed in testing for *Ni* (*Co*), *Cu*; *Cr*, *Mo*, *S*.

Magnesium, Metallic.—In the form of fine powder. Reducing agent. For *Nitric acid*, *Se*, *Te*, and for separating *Zn*, *Cd*, etc., from other metals.

Mercuric Chloride.—Powdered. Reagent for *Sn*, *I*. Its chief value as a reagent is when combined with ammonium sulphocyanate.

Potassium Iodide.—Powdered. Employed both alone and in combination with other reagents to increase the delicacy of the test. (*Cu*), *Hg*, *Tl*, *Pb*; *As*, *Sb*, *Bi*; *Nitrites*, *Se*.

Potassium Ferrocyanide.—Finely Powdered. This is easily accomplished after drying the salt in an air bath. Capable of giving more or less characteristic reactions with a number of elements; chief among them may be mentioned *Ca* (*Sr*), *Ba*; *rare earths*; *Ti*; *Fe*, *Cu*, *Rh*.

Rubidium Chloride.—Is of limited application, its chief value lies in detecting *Pt*, *Ir*.

Silica.—Pure precipitated SiO_2 in very fine powder. Reagent for *F*. In connection with Hydrofluoric acid gives rise to Hydrofluosilicic acid, q. v.

Silver Nitrate.—For the *Halogens*, *V*, *As*, *Cr*.

Sodium Acetate.—Dried and powdered. Used in place of ammonium acetate to neutralize effects of strong acids; in combination with uranium acetate as a test for *Mg*; with magnesium acetate in testing for *uranium*.

Sodium Bicarbonate.—Heated in a platinum cup supplies the normal carbonate for fusions, etc. Employed also as a precipitant. Serves in examinations for *Zn*, *Cd*, *rare earths*, *Cb*, *Mn*, *Cr*.

Sodium Chloride, or acetate in HCl solution. Enters into a number of important reactions in connection with other reagents. Not used alone, except for F.

Sodium Sulphate.—Chief use as a precipitant of the rare earths, with which it gives more or less crystalline compounds. Is generally better than potassium sulphate, but in separating Yttria earths from those of Cerite group the potassium salt seems to be preferable.

Sodium Phosphate.—The *Di-sodium phosphate*. Will be found valuable in testing for NH_3; *Li*, *Mg*; *Mn*; *Mo*, *W*; *Ni*, *Co*.

Stannic Chloride.—Either in the solid form or as a saturated solution. Generally combined with other reagents as a test. Useful for NH_3, *Rb*, *Cs*, *Au*.

Thallous Nitrate.—This reagent, like ammonium sulphocyanate, gives intensely interesting crystalline compounds which are of great value in microchemical testing. (*Thallous sulphate* can be advantageously employed if the nitrate is not procurable.) It can be recommended as a reagent for the *Halogens*, *V*, *Cr*, *Mo*, *W*, *U*; *Au*, *Pd*, *Pt*.

Tin.—Pure metallic tin in the form of thin foil. Can be utilized as a

reducing agent or for the production of Stannous chloride. Serves in the examination of compounds of *Hg*, *P*, *As*, *Sb*, *Bi*.

Uranium Acetate.—(Uranyl Acetate.) Or less efficient Uranyl nitrate. Fine powder or minute crystals. A very valuable reagent for *Na*, *Mg*, *Gl*.

Zinc Acetate.—Employed in the form of fine powder in combination with other reagents to increase the delicacy of a reaction, or to produce more characteristic tests. Renders good service in searching for *Na; As; U; Co*, *Cu*.

Zinc.—Thin, sheet, metallic zinc. Utilized as a reducing agent. Valuable for removing Cu, etc.

II.—REAGENTS LESS FREQUENTLY EMPLOYED OR SERVING IN SPECIAL TESTS.

Alcohol.—Convenient for hastening crystallization and driving drops of liquid to the corner of the slide; also useful as a reducing agent.

Aluminum Nitrate.—For *Cs* or *sulphuric acid*.

Ammonium Oxalate.—Has been suggested as a reagent for the calcium group. The results are generally unsatisfactory, but a subsequent treatment of the precipitate with sulphuric acid brings ammonium oxalate within the range of fairly acceptable reagents. Can advantageously be employed in separating *Thorium* from other *rare earths*.

Ammonium Silico-molybdate.—This reagent can be advantageously employed for distinguishing *Rb* and *Cs* from the remainder of the alkalies, and, under proper precautions, Rb and Cs from each other.*

Bismuth Sub-nitrate (*basic Bismuth nitrate*). Used with sulphuric acid as a convenient method of distinguishing between *Li*, *Na*, *K*, although other methods are generally preferable.

Cadmium Nitrate.—Employed for *Hydrogen sulphide*.

Cobalt Acetate.—With ammonium sulphocyanate gives a very beautiful crystalline compound with salts of *mercury*.

Formic Acid.—Better, *ammonium formate*. Reagent for *rare earths*.

Glycerine.—Useful in preventing drying of test drops.

Hydrogen Peroxide.—Valuable as an oxidizing agent and for separation of *Mn*. It must be remembered, however, that the hydrogen peroxide on sale contains relatively large amounts of mineral acids, alkaline earths, etc.

Indicators.—*Litmus* (purified), *Lacmoid*, *Congo Red*, are the most serviceable.

Iron.—Metallic iron in thin sheets. Serves to make salts of iron and to remove copper from solutions to be tested for other metals. A piece of this sheet-iron about two cm. square will be found convenient. It should be rubbed

* The reagent can be easily made by the following method: To 10 cc. of a 34°B solution of potassium silicate (liquor potassii silici) add 30 cc. distilled water; stir very thoroughly; then add *rapidly*, with constant stirring, 30 cc., or more, of dilute nitric acid (1 part HNO_3 sp. gr. 1.42 to 4 parts H_2O). To this acidified solution add a hot saturated solution of ammonium molybdate (25 to 35 cc.). Heat the mixture to boiling in a porcelain evaporator, and add 15 to 20 gms. ammonium nitrate. After continuing the boiling for about a minute or two, allow to cool. Ammonium silico-molybdate separates as a dense lemon yellow crystalline precipitate. Should the solution turn green during the boiling, more nitric acid must be added. The mother liquor is poured off the precipitate, and the latter washed rapidly with a concentrated solution of ammonium nitrate, and sucked dry with a filter-pump; it is then recrystallized from hot water, dried, and kept for use in the solid state as fine powder. Saturated solutions of this reagent cannot be satisfactorily kept.

bright with fine emery paper. If kept in stock, cut in convenient strips, rub bright and place in a wide mouthed bottle over lime or soda-lime to prevent rusting.

Potassium Chloride.—Powdered. Used as a source of potassium in reactions. Reagent for *platinum.*

Potassium Chlorate.—Fine powder. As an oxidizing (chlorinating) agent.

Potassium Antimonate.—Gives neat crystalline compounds with *Li*, *Na*, *Ca*, *Mg*.

Potassium Antimony Tartrate (*Tartar emetic*).—Produces fine crystals with *Ba*.

Potassium Chlorplatinate.—Employed for detecting *Rb*, *Cs*.

Potassium Ferricyanide.—Can serve in testing for *ferrous iron*, also *Zn*, *Cd*.

Potassium Hydroxide.—Dried in desiccator, warmed and powdered. If care is taken to keep this compound dry and the bottle tightly corked, its action on the glass is reduced to a minimum. Serves to make alkaline solutions, liberate NH_3, etc.

Potassium Nitrate.—Oxidizing agent in fusions with sodium carbonate.

Potassium Oxalate (*Normal*).—Valuable for *Gl; Sn*, *Bi*.

Potassium Oxalate (*Acid* or *Dioxalate*).—Employed in testing for *Zr*, *Rh*.

Potassium Permanganate.—Useful in rare cases. *Co*, *Perchlorates*.

Potassium Sulphate.—With H_2SO_4 in testing for *Bi;* with platinum sulphate for *halogens*. Heated with strong sulphuric acid is employed in decomposing minerals, etc. Valuable in separating rare earths.

Potassium Tartrate.—In analysis of *Calcium group*.

Sodium Hydroxide.—Dry. See remarks under potassium hydroxide. For making salts of sodium, alkaline solutions, etc.

Strontium Acetate, or *Strontium chloride or nitrate.*—Can be employed in testing for CO_2 and for *Sn*.

Starch.—Potato or Arrow-root Starch. For *Halogens*, *Nitrous Acid*, etc.

Tartaric Acid.—Powdered. Useful as a solvent for Sb_2O_3, and as a test reagent for *K*, *Rb; Ca*, *Sr*, *Ba*.

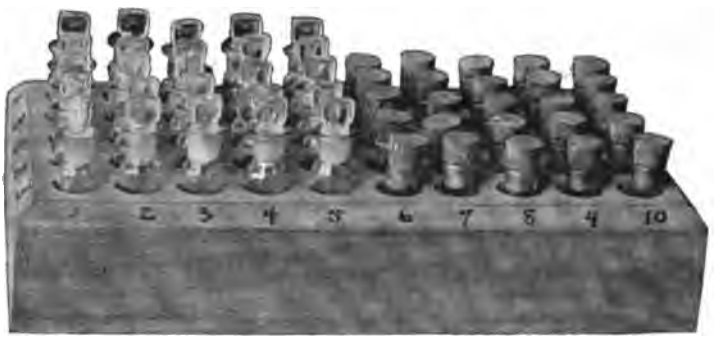

Fig. 12.

Since in all micro-chemical work only a minute amount of material is employed for an examination, the quantities of reagents are also necessarily small. It is possible, therefore, to have the required chemicals for all ordinary cases occupy but little space.

Reagents are conveniently kept in small glass or rubber stoppered vials of about two grams capacity. These are placed in holes bored in a block of wood. In the laboratory at Cornell, students are supplied with a block holding fifty of these little tube-vials, half of them glass stoppered (Fig. 12). The blocks are made as small as possible, and when not in use are placed in the drawers of the tables. All ordinary reagents are to be found in this set. Chemicals for special work are placed on the laboratory shelves; strong acids in the hood; weak acids, ammonium hydroxide, and distilled water in dropping bottles with Barnes pipettes. The pipettes are drawn down to an opening of rather less than

Fig. 13.

1 mm. Tiny drops are removed from this end for use, by means of a glass rod or a platinum wire. The pipettes themselves are employed to apply reagents only when large amounts are required, since in all ordinary cases the smallest drop of liquid they are capable of delivering is far too large. The reason for employing a dropping bottle at all, is because it is much easier to remove a minute drop from the tip of a pipette than it is from within a bottle, for in withdrawing the rod or wire to which a tiny drop is clinging by capillarity, great care must be exercised to avoid touching the neck of the bottle.

For travel or field work probably nothing can surpass the neat and compact reagent case of Behrens (Fig. 13).* A box 14 x 9 x 9 cm., outside measurements, contains a block of light wood bored with sixty holes, into which fit the tube vials, part of which are fitted with ground glass, part with rubber stoppers. In the latter are placed liquids and chemicals which have a tendency to cause glass stoppers to stick tightly. These tube-vials are 8 to 10 mm. in diameter and about 50 mm. long. Ammonium fluoride is placed in a tube of ebonite of the same size as the vials, and is closed with a screw stopper of the same material. The lower part of the box is provided with a drawer in which are kept the accessory apparatus before mentioned, and also the sheet metals given in the list of reagents. This little box contains, therefore, all the requisite apparatus (save, of course, microscope and source of heat) and material for making inorganic qualitative analyses.

Chemical Laboratory, Cornell University. E. M. CHAMOT.

The Bacteriological Department of Charing Cross Hospital, Eng.

Laboratory diagnosis, as distinguished from the clinical diagnosis of disease, has of late years advanced with giant strides, and Bacteriology, the youngest of the experimental sciences, has contributed largely to this development.

The examination of blood, pus, etc., by laboratory methods, enables the bacteriologist to afford very material assistance to the physician or surgeon; but in order that investigatious of this nature may be of the greatest value, the work must be so organized as to be readily and easily available. The methods in vogue to ensure this necessarily vary with different hospitals and laboratories, and your Editor has invited me to describe the means I have adopted to attain this end in my special department at Charing Cross hospital, and which I find work well.

The Collection of Material. It is obvious that in order to obtain reliable and consistent results, our first efforts must be directed to the proper collction of the varied material intended for examination; and as this part of the work frequently devolves upon the resident house officers, clinical clerks and surgical dressers, suitable, and at the same time simple apparatus must be devised for the purpose.

The apparatus in use here conforms to these requirements, and consists of a small box, containing a supply of sterile test tubes, swabs, pipettes and diphtheria outfits—together with blank report forms. One of these boxes is placed in the charge of the sister of each medical and surgical ward of the out-patient department, of the casualty department and of the operating theatre.

1. *The Box.* This is a plain pine wood box of $\frac{7}{16}$-inch stuff, measuring $7\frac{1}{4}$ inches in height, $10\frac{1}{2}$ inches long and $8\frac{1}{2}$ inches from front to back (outside measurements), closed by a "caravan" lid $2\frac{1}{4}$ inches deep, hinged on and secured in front by means of a couple of brass hooks.

* These reagent cases can be obtained of P. J. Kipp & Zonen, Delft, Holland.

The interior of the box is subdivided by a vertical partition running from front to back, placed 2¼ inches from one end. The narrow space thus formed accommodates eight diphtheria outfits, whilst the larger space is fitted with a horizontal sheet of wood, 4 inches above the bottom, pierced by twenty ¾-inch holes (arranged in four rows of five each) to form a rack for test tubes.

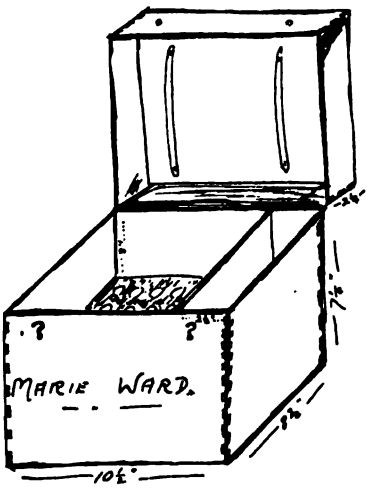

Fig. 1.

The interior of the lid is utilized for the storing of report blanks which are held securely in place by means of two transverse elastic bands. (Vide Fig. 1.)

2. *Sterile Test Tubes.*—The test tubes are those in general use in the laboratory —thick tubes of the best soda glass, 7 x ⅝ inches, without lips. They are plugged with absorbent cotton-wool and carefully sterilized in the hot air chamber before being placed in the box. Each box contains ten sterile tubes.

3. *Sterile "Swabs."*—A "swab" is made by winding a small quantity of cotton wool around one end of a six-inch length of soft iron wire (of about $\frac{1}{16}$-inch diameter). This is placed inside a test tube, which is plugged with cotton wool and then sterilized. Five such "swabs" are included in each box.

4. *Sterile "Blood" Pipettes.*—The pipettes are of the pattern suggested by Pakes for the collection of blood for the Typhoid reaction (*Lancet*, May 29th, 1897) and are made from ½-inch bore, soft glass tubing; the central barrel is about 1 inch in length, the narrow ends are 1½ inches long, and their calibre is sufficiently large to obviate capillarity (vide Fig. 2*a*). A small piece of cotton wool is placed in the bottom of a test tube, a pipette and a hare lip with lance shaped point (Fig. 2*b*) pin are inserted, and the tube is plugged. This piece of apparatus is then sterilized and is ready for use. Five of these pipettes are to be found in each box.

Fig 2.

5. *Diphtheria Outfit.*—This consists of a flat tin box, 7 x 2 x ¾ inches, provided with a hinged lid and containing one sterile swab and one tube of inspissated blood serum (slanted). For the blood serum, by the way, a test tube 5 x ⅝ inches

is used, in order that the surface of the medium may be inoculated from the swab (which is six inches in length) without risk of contamination by the fingers of the operator. One end of the tin box has the word "Top" painted on in red, to minimize the danger of inverting the tube of medium. Four or five of these outfits are included in each of the ward boxes, whilst those boxes kept in the out-patient and casualty departments each contain a full complement of eight.

6. *The Report Blank.*—This is a sheet 8 x 6 inches, having on the one side printed headings for patient's name, etc., and space for the report; and on the other side, directions for collecting material. The accompanying cuts show the two sides of the report form.

CHARING CROSS HOSPITAL.

Specimen for Bacteriological Examination.

Physician or Surgeon _____ *Ward & Bed, or No. of P. M.* ____

Name of Patient _____ *Disease* _____

Material? *Source?* _____

Investigation required. What organism suspected? _____

Date _____ *Signed* _____

This Form must be duly filled up, and signed by a member of the Staff, one of the Registrars, the Resident Medical Officer, or House Physician or House Surgeon.

When investigations necessitating inoculations are required, this Form must be signed by a member of the Staff.

REPORT.

Date _____ *Signed* _____

[SEE OVER.]

INSTRUCTIONS.

I. Directions for collecting PUS and other exudates.

(*a*) Pus and other fluids should be collected in sterile test tubes in the following manner:—The cotton wool plug and the lip of the tube should be flamed over a spirit lamp. The plug should then be removed, and a small quantity of the fluid run into the tube, the mouth of the tube again flamed, and the plug replaced. The plug should be held in the hand during the proceeding.

(*b*) If the quantity of fluid is too small to be collected in the above manner, it should be soaked up with a sterile swab, which should then be replaced in its tube.

II. Directions for making Cultivations in cases of Diphtheria.

(Boxes containing sterile swabs and blood serum tubes are provided for use in cases of suspected Diphtheria *and for these cases only.*)

1. Withdraw the swab from the tube, and apply it to the affected part so as to remove a little of the exudation. Take care that the swab does not touch the tongue or cheek in doing so.
2. Smear the surface of the blood serum lightly with the swab, and replace the cotton wool plug.
3. Put the swab back in its tube, and replug the tube. Take care not to lay down the swab or cotton wool plugs either before or after making the cultivation.

(N. B.—Do not make the cultivation immediately after the throat has been treated with an antiseptic.)

III. Directions for collecting BLOOD for the Typhoid Reaction, etc.

1. Clean the lobe of one ear thoroughly with Lysol (2 per cent.), then with Methylated Spirit; dry it completely with the sterile cotton wool plug from the test tube containing the pipette.
2. Remove the sterile needle and pipette from the tube, and prick the lobe of the ear with the needle. Squeeze the lobe, and as the blood issues, bring one end of the pipette into contact with the drop and depress the other end—the blood runs into the narrow tube by gravity, and fills it. Now suck the clean end of the pipette gently so that the blood flows into the bulb.
3. Rest the pipette on the open mouth of a tumbler, or other suitable stand, so that it is quite horizontal, and allow the blood to clot—10 or 15 minutes will suffice. Now seal off both ends of the pipette in a spirit lamp flame, and replace in the tube—*Clean end downwards.*

A BOX containing sterile test tubes, swabs, pipettes and Diphtheria Outfits is kept in each Ward, in the Out-Patient Department, and the Casualty Room.

N. B.—Every specimen must be accompanied by a Report Form, properly filled in.

So much for the collection of the material. The manner in which it is dealt with on its arrival in the laboratory can be explained in very few words.

A report book is kept in the laboratory in which to record the details of the examinations made, and the results obtained, in respect to every specimen sent up. This book is a quarto volume of faint ruled foolscap; the pages are numbered consecutively (one page for each specimen), and the top of each page is printed to correspond with the front of the report forms.

Immediately a specimen is received in the laboratory, the particulars of the case from which it is derived are copied from the report form onto a page of the report book, and the number of that page is attached to the specimen (and all preparations, cultures, etc., made from this, bear the same distinctive number).

The cultivations from cases of (?) diphtheria are now placed in the hot incubator, whilst the examination, by appropriate methods, of other specimens is commenced.

In the case of (?) diphtheria, a report is ready before noon on the morning following the receipt of the specimen; with other specimens the examination is continued from day to day until completion. As soon as each investigation is concluded a brief abstract of the results obtained is made from the report book to the space reserved for this purpose on the report form. The report is now folded and placed in an envelope, unsealed, and addressed to the physician or surgeon to whose case it refers; the name of the corresponding resident house officer is written in the left hand lower corner. The envelopes used for this purpose have the words "Report from the Bacteriological Department" printed across the top. Rendered conspicuous in this manner, the report is placed in the letter rack at the hospital entrance, and can thus be readily referred to by the resident in charge of the case, in the interval between his chief's visits, and then replaced for the latter's perusal.

The only other point in connection with this system, which needs mention, relates to the maintenance of the collection boxes. Every Wednesday morning the laboratory assistant visits each of the wards and inspects the box, replenishes its stock of sterile tubes, pipettes, etc., examines any unused diphtheria outfits, and in the event of any of the serum tubes showing signs of drying up, replaces them by fresh ones.

J. W. H. Eyre, F. R. S.

Bacteriologist to Charing Cross Hospital, and Lecturer on Bacteriology in the Medical School, Edinburgh.

The Bacteria in the Stomach of the Cat.

Julius Weiss.

V.

EXPERIMENTS IN THE PRESENT INVESTIGATION.

In Part II it was pointed out that a large number of organisms of different species may be isolated from the mucosa of the stomach, or from the contents of the parchment tubes during the very height of digestion, when the acidity in the stomach or in the tube is relatively very high. The presence of bacteria during all stages of digestion being established, the following questions may be asked:

Are these bacteria that are present in the stomach rendered inactive during their sojourn in that organ by the HCl of the gastric juice, or do they remain active and exert an influence in digestion?

What influence, if any, do these organisms bring to bear in the intestines after they enter these from the stomach, together with the food?

In the attempt to answer these questions, a number of experiments were performed which will be described below.

While I feel reluctant at this moment to say that the results obtained in these experiments are final, they nevertheless indicate certain conditions that may be found in the presence or absence of those organisms. It will naturally be recognized by all that a large number of various experiments in these lines still remain to be done before anything definite can possibly be established with regard to the rôle bacteria play in digestion.

The questions indicated above will now be discussed, but in reverse order.

As the principal object of this part of the investigation is to treat of the influence that bacteria may bring to bear in the stomach by their presence in that organ, no extensive experiments were performed with reference to their behavior in the intestines. The experiments which were performed, however, with reference to this subject, as well as those of previous investigations, prove conclusively that the bacteria present in the stomach may gain an entrance into the intestines, and whether or not their activity has been interfered with while in the stomach, as soon as they find themselves in the intestines they show extensive vitality and exert considerable influence.

By examining the table in Part I, which gives the biochemic characteristics of the bacteria studied in this investigation, it will be seen that quite a number of them have the power to produce acids. Whether or not they retain this property in the stomach will be discussed a little later. Here their behavior with this respect in the intestines will be taken up.

In all the standard physiologies it is almost invariably stated that digestion in the small intestines takes place in an alkaline medium. In one or two of these books, however, the authors modify this statement by adding a few remarks on the experiments made by McFadyan, Nencki, and Sieber (38), in 1891, in the case of a woman under their observation, who had a natural fistula in the ileum immediately above the valve. As is well known, they found that the intestinal contents passing out through this fistula were invariably acid. From this the observers conjectured that the reaction in the entire intestine is acid.

In his book, published in 1898, Gillespie (41) makes the statement that the intestinal contents in a dog, during digestion, are acid.

These two observations may go to indicate that digestion in the small intestines can take place in an acid medium.

The observations of McFadyan, Nencki, and Sieber led me to make a number of tests of the intestinal contents of cats at different stages in their digestion, and under a number of varying conditions. The tests were invariably made from the pyloric orifice to the anus.

As the results obtained were, with slight exceptions, the same in all the ten animals examined, it will be sufficient here to describe a single case and noting the important exceptions afterward.

The following conditions were present in one of the typical cases examined :

1. The cat (male) under the influence of chloroform.
2. Heart pulsating.
3. Temperature at the arch of the aorata, 39° C.

4. Temperature between the lobes of the liver, 40° C.
5. Temperature at the pylorus, 36° C.
6. Temperature between the small intestines, 39° C.
7. Temperature at the caecum, 37° C.
8. Stomach moderately distended with food; reaction, decidedly acid.
9. Duodenum contains a slight amount of food; reaction, decidedly acid.
10. Jejunum, distended with food; reaction decidedly acid.
11. Ileum contains only a trace of food; reaction faintly acid.
12. First part of colon distended with food and gas; reaction decidedly acid.
13. Last part of colon contains fecal matter in advanced stage of decomposition; reaction neutral.

In two other cases examined, where the food had all passed out from the stomach and small intestines, but was present in the colon, the following reactions were obtained:

1. Cardiac part of stomach, alkaline.
2. Fundus and pyloric region of stomach acid.
3. First ten centimeters of duodenum slightly acid.
4. Rest of the small intestines, except the part near the caecum, neutral.
5. Ileum a few centimeters beyond the caecum, alkaline.
6. First part of colon slightly acid, last part neutral.

All the cats used in these experiments were fed on crackers and milk. Fermentation elements, evidently, were quite abundant in this diet.

While the experiments just described were being made, Nesbitt (43) reported that the reaction of the contents of the small intestines in dogs that he experimented with for the detection of cholin and neurin, gave an acid reaction. The intestines in his experiments, however, were completely obstructed by ligatures at the ileo-caecal valve.

From the results obtained with this respect, in the present investigation, it may be stated that in the small intestines the carbo-hydrates ingested undergo fermentation, due to the action of certain species of bacteria present in that organ, giving an acid reaction to the intestinal contents. It may also be added that this acid reaction may be obtained at any point in the small intestines where food of a carbohydrate nature is present.

In view of the results obtained, one may be justified to depart from current opinion, which holds that bacteria are incapable of producing fermentations in the small intestines, and adopt an opposite view, that they are able to ferment at least part of the carbohydrates ingested, even under normal conditions.

These experiments, however, have not been carried far enough to allow me to say with definiteness what other rôles bacteria play in intestinal digestion—considerations which I hope to take up in the future, if opportunity offers. Experiments, however, have been performed for the purpose of gaining an idea of some of the relations that exist between digestion in the stomach and the bacteria present in that organ during the digestive processes.

Before, however, entering into a discussion of the experiments performed and the results obtained, it may perhaps be well here, also, to make a few remarks with reference to the methods employed in this part of the investigation.

Table Indicating the Relations of Bacteria to Digestion.

Series of Expt.	In Cylinder.	In the Parchment Tube.	Xantho-proteic Test.	Alcohol Test.	Tannic Ac. Test.	Bulk % of Peptone Pptd.	Final Acidity in the Tube.	Final Acidity in the Cylinder.
A	150 cc. Dist. water.	100 cc. bouillon + stomach bacteria.	—				.036%	.021%
B	150 cc. .2% HCl.	100 cc. bouillon + stomach bacteria.	—				.159%	.105%
C	150 cc. .2% HCl.	150 cc. bouillon + 15 cc. sterile pepsin sol.	+				.138%	.094%
D	150 cc. .2% HCl.	150 cc. bouillon + 15 cc. sterile pepsin sol. + stomach bacteria.	+				.160%	.094%
E	150 cc. Dist. water.	100 cc. bouillon + boil. egg + stomach bac.	—				.043%	
F	150 cc. .2% HCl.	100 cc. bouillon + boil. egg + stomach bac.	—					
G	150 cc. .22% HCl.	100 cc. bouillon + boil. egg + 15 cc. sterile pepsin.	+					
H	150 cc. .2% HCl.	100 cc. bouillon + boil. egg + 15 cc. sterile pepsin sol. + stomach bacteria.	+					
I	300 cc. .2% HCl.	100 cc. bouillon + 25 cc. pepsin sol. + 25 cc. culture.	+					
K	300 cc. .2% HCl.	100 cc. bouillon + 25 cc. pepsin sol.	+					
L	150 cc. Dist. water.	50 cc. bouillon + egg white + stomach bac.	—					

M	150 cc. .2% HCl.	50 cc. bouillon + egg white + 10 cc. pepsin solution.	+					
O	100 cc. .2% HCl.	25 cc. egg white + 25 cc. sterile pepsin sol.	+	+	+	2 cc. sol. = .15 cc. centrifuge bulk.	.131%	
P	100 cc. .2% HCl.	25 cc. egg white + 25 cc. pepsin sol. + bacteria Nos. 18, 21, 24, 25, 26, 28.	+	+	+	2 cc. sol. = .075 cc. centrifuge bulk.		
Q	50 cc. .2% HCl. + 80 cc. Dist. water + 25 cc. egg white stomach bacteria.						.058%	
R	130 cc. Dist. water + 25 cc. egg white + stomach bacteria.							
S	50 cc. Dist. water.	50 cc. sol. Q.	—		—			
T	50 cc. Dist. water.	50 cc. sol. R.	—		—			
U	85 cc. .2% HCl. + 50 cc. egg white + 15 cc. pepsin sol. + stomach bacteria.							
V	85 cc. .2% HCl. + 50 cc. egg white + 15 cc. pepsin sol.							
W	100 cc. Dist. water.	40 cc. solution U.	+		+	10 cc. sol. = .8% centrifuge bulk.		
X	100 cc. Dist. water.	40 cc. solution V.	+		+	10 cc. sol. = 2% centrifuge bulk.		

The same kind of media, reagents, and dialyzers that were used in the acid determination experiments were also used here. In addition, other reagents were added to the list, namely, a one per cent. solution of caustic potash, a one per cent. copper sulphate solution, ninety-five per cent. alcohol, and a twenty per cent. solution of tannic acid. This last was found to be a good reagent for precipitating peptones present in dialyzed liquids. The centrifuge with its accessories were employed in a few of the experiments, to determine the bulk percentages of peptones and other dialyzed substances present as the result of digestion.

Before taking into consideration any of the results obtained, tests were invariably made to determine the efficiency of the dialyzers.

The substances to be digested were kept at incubator temperature for five hours before tests for peptones were made.

The methods just described were employed on the assumption that if gastric bacteria have the power to produce peptones out of proteids, the peptones so produced ought to be detected in the dialyzed liquid the same as would be the case with peptones produced by the artificial action of pepsin ferment.

The bacteria to be tested were put in U tubes, in which proteids were present. These tubes were then placed in cylinders of the pattern already described in Part III. These cylinders, in turn, contained either a definite quantity of distilled water or HCl. The pepsin ferment was omitted in each case where the action of the bacteria alone was to be determined.

Experiments were further performed to determine the amount of peptones produced by definite quantities of pepsin ferments acting upon a known amount of proteids, in the presence and in the absence of bacteria. The dialyzers were employed in each of the experiments. The conditions in both with regard to the quantities of proteid material and pepsin ferment in the tubes and the HCl in the cylinders were the same. In one of them, however, the conditions were all sterile; in the other, bacteria from the stomach of the cat were added. The centrifuge bulk peptone percentages obtained in each case were compared and inferences were drawn from the differences observed to be present in each of the cylinders.

The table on pages 30 and 31 indicates briefly the different conditions that were present in each of the dialyzers and the results obtained in each experiment.

Upon examining this table it will be found that in no case was there obtained a test for peptones where the bacteria alone acted upon the proteids in the U tube, whether in the presence of distilled water or a two-tenths per cent. solution of HCl.

It will also be seen that in experiment O, in which all the conditions were sterile, 2 cc. of the dialyzed liquid gave .15 cc. centrifuge bulk of peptones; whereas in experiment P, in which gastric bacteria were present, 2 cc. of the dialyzed liquid gave only .075 cc. centrifuge bulk of precipitated peptones. It will likewise be noticed that in experiments W and X similar results were obtained.

Although no final inference can be drawn from these experiments, nevertheless they indicate that bacteria exert quite an appreciably detrimental influence during digestion. The results obtained also indicate that the bacteria in their

sojourn in the stomach are not rendered inactive by the HCl of the gastric juice—at least they are not rendered entirely inactive, and can still exert a certain amount of influence by their presence in that organ even during the height of secretion.

To further strengthen the statement that bacteria are not rendered entirely inactive under these conditions, it will be necessary to examine the figures given in the last two columns of the table referred to, under the head of final acidities.

In experiment A the acidities in the beginning were, in the parchment tube, .0232 per cent.; in the cylinder 0 per cent. At the end of five hours digestion, the acidities were, in the parchment tube, .036 per cent.; in the cylinder .021 per cent., a total of .0285 per cent., or an increase of .0053 per cent., which increase represents the amount of acid produced by the action of the bacteria alone.

Is this acid producing power of bacteria checked in peptic digestion by the HCl?

To answer this question it will be necessary to examine experiment C, in which the conditions were sterile and 150 c. c. of the HCl present in the cylinder. It will be seen that the final acidity in this case was .138 per cent. In experiment D, however, in which bacteria from the stomach were present, though the amount of HCl (150 c. c.) in the cylinder was the same as in C, the final acidity in the parchment tube was .160 per cent. This increase in the acid percentage must be attributed to the action of the acid-producing bacteria that were present in the parchment tube.

These results, therefore, also go to indicate that the activity of bacteria is not entirely checked by the HCl in peptic digestion.

CONCLUSION.

The following is a brief summary of the facts that presented themselves in this investigation, and which were briefly described in Parts I, II, III, IV, and V, respectively:

1. A large number of bacteria of various species may be isolated from the gastric mucosa of the cat during the height of digestion when the secretion of HCl is at a maximum.

2. At the end of twenty-four hours fasting, only a few organisms of the more resistant species may be isolated from the gastric mucosa of this animal.

3. A large percentage of the species of bacteria thus obtained have the power to produce indol, acidify, and coagulate milk, and ferment glucose, lactose, and saccharose with or without the production of gas.

4. The HCl secreted in the stomach during digestion combines with the proteids present in that organ, forming acid-albumin, a substance acting as a very weak germicidal agent.

5. The fact that most of the HCl secreted during digestion combines to form acid albumin explains why bacteria present under these conditions can thrive in a comparatively very high acidity.

6. The important germicidal factor in gastric digestion is the free HCl. This agent, however, does not appear in any appreciable quantity in the free state until most of the proteids present in the stomach or dialyzer have been transformed into acid-albumen and peptones.

7. In the passage of the stomach contents into the intestines, many bacteria are carried along and may be isolated from the intestinal mucosa.

8. Those bacteria which produce acids do not have this power checked when in the small intestines.

9. The same acid-producing power of the bacteria, as was shown by the results obtained in the dialyzers, is not entirely checked during gastric digestion.

10. Many species of bacteria that enter the stomach can exert an influence in that organ, whatever that may be, even during the height of digestion.

11. The bacteria isolated from the gastric mucosa in this investigation did not have the power to produce peptones.

12. As indicated by the results obtained in the quantitative tests in Part V, the presence of bacteria in the proteids during peptic digestion causes a marked reduction in the amount of peptones formed.

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LABORATORY PHOTOGRAPHY.

Devoted to methods and apparatus for converting an object into an illustration.

ABOUT MAKING BLUE PRINTS.

We glean the following method from the British Journal Photographic Almanac:

PRINTING.—A fairly strong, plucky negative gives the brightest results. Printing should be in a strong light, and may be in direct sunshine.

A DRAWING, DIAGRAM, ETC., consisting of black lines on white paper, may be used instead of a negative. The resulting print shows, of course, as white lines on blue ground. Where reversal of the picture (right to left) is of no consequence, the sharpest results are obtained by putting the face of the engraving in contact with the sensitized surface and printing through the back of the engraving in direct sunlight.

Name of diagram, etc., may be written in red if ordinary red ink is acidulated with oxalic acid. The acid removes the blue color, and the red ink remains. One part of acid in twenty of ink will generally be found satisfactory.

DEVELOPMENT essentially consists in washing (dissolving) the unaltered parts of the sensitizing mixture. The washing water should be as free from lime or chalk as possible. If lime is present to any great extent, carbonate of iron may be formed and the lights stained.

Prolonged washing in running water, or in frequent changes, helps to clear the whites.

TO BRIGHTEN THE COLOR OF THE PRINTS, a trace of acid, e. g., citric, hydrochloric, etc., may be added to the washing water.

OVER-EXPOSURE can be partly counteracted by bathing the print in a very dilute solution of ammonia; e. g., begin with ten drops of strong ammonia in a pint of water, and add a few drops at a time until the print is lightened sufficiently. Again, a dilute solution of oxalic acid (say, five per cent.) has a similar action.

UNDER-EXPOSURE may, to some extent, be compensated for by developing the

prints in a dilute solution of iron perchloride. The proportions of perchloride recommended vary from 1 in 300 to 1 in 120 of water; but 1 part of iron to 200 parts water will be found a generally useful strength. Iron protosulphate or iron nitrate may be used in place of the perchloride with similar results, but the last-named seems the favorite.

REDUCTION OF AN OVER-PRINTED PROOF.—Immerse the print in a five per cent. solution of caustic potash until the image turns pale yellow. Wash well, and transfer to water containing a little hydrochloric acid (10 drops per ounce). The print again becomes blue, but is reduced in strength generally.

INTENSIFICATION.—This may be done by immersing the print in a five per cent. solution of potassium sulphocyanide.

TONING BLUE PRINTS.—Many experiments have been made with a view to altering the color of a blue print. In certain directions considerable success has resulted.

BROWN-BLACK.—The print, having been previously well washed and dried, is immersed in dilute ammonia (5 to 100) until the image is almost invisible. Again washed and transferred to a bath of tannic acid (5 in 100), washed and dried.

Or immerse the print first in dilute caustic potash (3 in 100), rinse and transfer to tannic acid bath (5 in 100). In place of caustic potash, we may use potassium carbonate solution (5 in 100).

FOR RED-BLACK TONES reverse the alkali-tannic procedure thus: Soak the print for five to ten minutes in a bath of tannin (1 in 25); then transfer to a bath of soda carbonate of similar strength (1 in 25).

BLUE BLACK.—Print strongly till shadows bronze; dip in water, then in three per cent. solution of ammonia until pale violet; then immerse in a six or eight per cent. solution iron protosulphate.

DEEP BLUE TONES.—Of saturated solution of ferrous sulphate take eight parts, add eight parts water, and then one part sulphuric acid.

SEPIA TONES.—Bathe the print in caustic potash (1 in 20) until the image is of an orange tinge; then transfer to tannin bath (say five grains per ounce of water); then another dip in the caustic potash; then wash and dry.

LILAC TONES may be obtained by immersing the prints in a hot solution of lead acetate. Lilac tones also are obtainable by very dilute solutions of borax or potassium oxalate. If these lilac prints are dipped in dilute potassium sulphocyanide and exposed to light (without washing), they assume a slight pinkish tinge.

GREEN TONES.—To 100 parts water add five parts sulphuric acid; immerse the print until the desired tint is obtained, wash slightly, and dry. Again, prepare a thirty or thirty-five per cent. solution of potassium sulphocyanide. This bath gives tones ranging from moss-green to brown-black.

VARNISHING.—Blue prints may be varnished by applying with a brush a solution of Canada balsam in turpentine, and drying in a strong draught. Dammar varnish may also be used.

CORRECTIONS may be made, i. e., portions of the blue part removed, by applying with a quill pen or small brush, a strong solution of oxalic acid; or a strong

solution of washing soda may be used. Care must be taken to see that the action does not spread.

CONTRACTION OF THE PRINT.—Where this process is used for reproducing, etc., it is important to notice that, with certain papers, there is a general shrinkage or contraction in the paper. Therefore, the scale should always be included in the prints if measurements are to be made from the reproduction. The contraction may be as much as one per cent. of the linear dimensions.

TO CONVERT A BLUE PRINT INTO A LINE DRAWING.—Having previously well washed and dried the print, trace the outline, etc., with good Indian ink, rather thick, and let it dry thoroughly. Then dip the print for a few moments in a five per cent. solution of oxalic acid, or potassium oxalate, or ten per cent. washing soda, until the blue color is removed, leaving only the black lines. In place of Indian ink, waterproof ink may be employed.

RETOUCHING BLUE PRINTS.—Make a saturated solution of iron protosulphate and add to it a ten per cent. solution of potassium ferricyanide; collect and wash the precipitate. Mix with a little gum water and apply with small brush.

SUNDRY NOTES.—(*a*) Ammonia citrate of iron is also known as ammonio-ferric citrate, and as citrate of iron and ammonia.

(*b*) Potassium ferricyanide is sometimes spelled ferridcyanide; also known as red prussiate of potash.

(*c*) If blue fog occurs when using the green form of ammonio-citrate of iron, it is an indication that the sensitizing mixture contains too much potassium ferricyanide.

(*d*) If the light is not sufficiently strong to admit of the print being fully printed in the time available, it may be developed (when only partially printed) by immersing in the following: in two gallons (sixteen pints) of water, dissolve one ounce of chloride of iron and a like quantity of nitrate of iron.

Announcement is made for the thirteenth season of the Marine Biological Laboratory at Wood's Holl, Mass. The regular courses will be given in zoölogy, embryology, and botany, and among the newer features will be the department of comparative psychology, opened last summer, and a course in nature study given, with the coöperation of a number of specialists, for the first time.

The staff of instructors includes many of the most noted scientists and earnest workers in the country, and this, with the general spirit of *camaraderie* that pervades the place, makes it especially attractive to the biologists.

There is careful instruction in the elementary courses, and the study of living marine forms makes it possible to present the subject from a different point of view than can be given with the use of preserved material. In the advanced courses, the broader and more fundamental questions of biological science are attacked.

The work in comparative psychology is perhaps of especial interest from the fact that it lies in a field of which comparatively little is known. Among the subjects to be considered are the "Origin of Consciousness," the "Continuity of Human Mental Life with that of the Lower Animals," the study of young animals for the purpose of distinguishing between instinctive activities and those that result from experience, etc. The couse as outlined will have an important bearing on the questions concerning what activities are merely reactions to stimuli, and what ones are intelligent, with the general question as to whether mind is a property of protoplasm.

Journal of Applied Microscopy.

L. B. ELLIOTT, EDITOR.

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ONE who looks over the past century and views the great advancement of human knowledge during that period, will, without doubt, be impressed by the part that science has played in that marvelous progress.

As Dr. W. K. Brooks has said on a recent occasion, it is not the progress in science which this century has made, but the means and the opportunities for still greater progress which it has put into the hands of future generations, which has seemed, to thoughtful men, to be its greatest distinction. If the men of the twentieth century find themselves better equipped for the discovery of truth than any who have gone before, if they have more and better means for the extension of natural knowledge, and the relief of man's estate, they owe most of their advantages to the pioneers of the nineteenth century.

One of the most important instruments for scientific discovery which the nineteenth century has put into the hands of the twentieth century is the scientific laboratory, which may be said to have had its birth during the past twenty-five years.

The change to modern laboratory methods has given an impetus to scientific study, the fruits of which can be realized only as achievements already attained to be made of use in the solution of more difficult problems. However, the fruits of the laboratory are not all reserved for the future. We speak of our time as the age of invention; and if we look into this phase of development, we find that while there have been only seven scientific inventions of first rank in all human history up to the eighteenth century, there have been thirteen in the nineteenth century, and of these thirteen, eleven are the products of the laboratory. Laboratories have done even better things for mankind than the invention of natural comforts. They have taught the dignity of manual labor and the value of skilled labor. The laboratory is a place for work, a work-shop. The scientist, the student, is a man who works with his hands—a handicraftsman.

If we would seek the source of this great development in the modern scientific laboratory, we must turn to the microscope and its accessory appliances, the development of which, in construction and application, has ever preceded the advance of laboratory methods. That the microscope is to play a still more important part in our educational advancement is evidenced by the fact that it is fast finding its way into our secondary school system.

The men of the nineteenth century consign the scientific laboratory, with all of its successes and opportunities, to men of the twentieth century, and they have confidence that still greater heights of success will be attained. Yet it must not be taken for granted that the men of the twentieth century are destined to great things because they have great opportunities and advantages, for they are destined to do nothing except what they determine to do, and fight for, and succeed in doing.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to Charles J. Chamberlain, University of Chicago, Chicago, Ill.

REVIEWS.

Barnes, C. R. *Outlines of Plant Life*, with special relation to form and function. 8vo, VI + 308, 250 illustrations. Henry Holt & Co., New York, 1900.

This book has been prepared, at the request of the publishers, to meet the needs of those who prefer a simpler and less extensive work than is furnished by the author's book on Plant Life. The *Outlines* differs from the previous book (1) in the omission of all microscopic work, so that a compound microscope is not necessary where this text is used; (2) in the elimination of the greater part of the chapter on sexual reproduction, and (3) in the omission of less important paragraphs here and there, and in the reduction of others to smaller type. As a result, the book contains 120 pages less than the previous volume. The chapters on Physiology and Ecology have been less changed. The laboratory directions accompany the paragraphs to which they refer instead of being grouped together at the end of the book. There are two appendices, one on the collection and preservation of material, and the other upon apparatus and reagents.

While it is doubtless true that the earlier volume contained considerable detail, several long words and some statements which the average student could not master readily at the first effort, it seems deplorable that a revision should be called for on account of these objections. Even in the country schools Geometry and Physiology furnish the pupil with technical names as long and as difficult as the subject of botany has to offer, while the phenomena of Physics furnish as knotty problems as the structure and function of plants, and yet a book on Geometry, Physiology, or Physics, of the same grade of difficulty as the previous book on *Plant Life*, or Atkinson's *Elementary Botany*, or Coulter's books on *Plant Relations* and *Plant Structures* meets with little or no objection. It would seem that the problem should be solved by better preparation on the part of teachers, and more efficient work in nature study in the grades rather than in an effort to make a juvenile presentation of the subject matter of botany.

C. J. C.

Howe, E. G. *Advanced Elementary Science*, being Part II of Systematic Science Teaching, a manual of inductive elementary work. 8vo, X + 373. D. Appleton & Co., New York, 1900.

The reception accorded to the previous volume, which was designed for the lower grades, has encouraged the author to prepare the present book, which aims to furnish systematic work in natural science adapted to the needs of the grammar grades.

The subjects treated are: (1) The stars and the earth; (2) Minerals and Rocks; (3) Plants; (4) Animals. Lessons are graded and outlined for nine

years' work. The more obvious structures and relations of plants are dealt with in a suggestive manner, and the hints will be useful even where a systematic course in natural science has not been inaugurated. C. J. C.

Darbyshire, O. V. Ueber die Apothecienentwickelung der Flechte Physcia pulverulenta (Schreb) Nyl. Jahrb. f. wiss. Bot. **34**: 329–345, Pl. 11, 1899.

This paper is an important contribution to the subject of sexuality of lichens, and it strongly supports the views of Stahl and others who have described fertilization in the group.

Darbyshire was able to find trichogynes and archicarps. The trichogynes are slender, multicellular organs, projecting above the surface of the thallus: spermatia were often seen attached to this projecting portion. The archicarp is also multicellular, consisting of a few loose coils. After fertilization (a process which is not described) some of the cells of the archicarp enlarge and fuse, thus forming a multinucleate ascogonium from which come the numerous hyphae which give rise to the asci.

The writer thinks that the similarity of the trichogyne to that of the Collemaceæ, and also to that of the red algæ, is evidence of its character as a receptive organ.

A second paper is promised soon, and it is to be hoped that the extremely difficult problem of fertilization will receive attention. C. J. C.

CYTOLOGY, EMBRYOLOGY, AND MICROSCOPICAL METHODS.

AGNES M. CLAYPOLE.

Separates of papers and books on animal biology should be sent for review to Agnes M. Claypole, Sage College, Ithaca, N. Y.

CURRENT LITERATURE.

Berry, J. M. On the Development of the Villi of the Human Intestine. Anat. Anz. **17**: 242-249; 6 figs., 1900.

Literature on the subject of the development of villi was found by the author to be very meager, but it was known that villi appear earlier in the duodenum than in lower regions, showing the appearance of these structures to be progressive. The steps found in studying human embryological material most strikingly follow those already marked out in comparative anatomy as shown in the work of Oppel. Three points were considered in carrying out these studies: first, the number of villi present in the embryos of different ages; second, the forms of the villi in the different stages, these are obtained by Bone's reconstruction method; third, the form of the villi in different parts of the same intestine. Villi from the pig's intestine were also carefully studied in these cases by spreading the opened embryonic intestine on glass and directly counting the villi in a .01 square mm., also carefully estimating the whole area. Often camera drawings of the villi in a given area were made. The number of villi was found to increase markedly with increasing age and

length of intestine in older embryos. The smallest embryo, either of pig or man, in which villa are well marked are over 50 mm. long, and from their first appearance villi number over 25,000. The number of villi increases with the age of the embryo; fully developed and young villi are found in the growing intestine side by side. All villi appear at first as longitudinal folds, which increase in size and break up into villi. Villi appear first at the upper end of the intestine.

A. M. C.

Loeb, J. On Ion-Proteid Compounds and Their Rôle in the Mechanics of Life Phenomena. I. The Poisonous Character of a Pure NaCl Solution. Am. Jour. of Physiol. 3: 327-339, 1900.

This is the first of a series of articles dealing with the constitution of living matter, and putting forth some new ideas and facts regarding it. The new facts are that the salts or electrolytes present in living matter are not in the tissues as such exclusively, but are partly in combination with proteids. The salt is not in combination as a whole, but through its ions. The importance of this fact is that by the substitution of one ion for another the physical properties of the proteid compound changes; as, for instance, their power to absorb water. Hence, by varying the ion combination in a tissue, a means of varying and controlling life phenomena is obtained. It was found by experimentation that muscle does not absorb the same amount of water in equi-molecular solutions of various chlorides. In a .7 per cent. solution of NaCl muscle absorbs about 7 per cent. of its own weight in 18 hours, but about 40 to 50 per cent. of its own weight in an equimolecular solution of KCl; in $CaCl_2$ it lost 20 per cent. of its weight of water, while in HCl no change occurred either way. These effects of metal ions upon the absorption of water parallel remarkably the influence of the same ions on soaps. The potassium soaps absorb large quantities of water, and sodium and calcium soaps much less in order named. The idea is advanced and well sustained that the proteids in muscle take the place of the soaps in the action of the metallic ions.

This conception of ion-proteid compounds was next applied. Rhythmical contractions of the skeletal muscles—a phenomenon only occasionally observed, —was found to occur only in solutions of electrolytes, in compounds capable of ionization. In solutions of non-conductors, as urea, sugars, and glycerine, such contractions were impossible; moreover, they are only possible in certain ion solutions. All of the sodium salts are able to produce them, but .7 per cent. of sodium chloride is less efficient than a similar solution of sodium bromide. It was further found that such contractions only occur if enough calcium ions are also present in the tissues, but if calcium or potassium ions are added to the sodium solutions, rhythmical contractions cease. This indicates that the substitution of certain calcium ions by sodium will cause contractions of the kind under discussion, but an excessive removal of calcium prevents further action. Hence it is due to the presence of calcium and potassium ions in the blood that skeletal muscles do not contract rhythmically. Experiments were carried out on Fundulus—a marine fish—which showed clearly that this form could live in salt water to which 5 per cent. of Na Cl had been added, but that it dies very quickly in pure Na Cl solution of concentration equal to that of sea water, while young fish could live indefinitely in distilled water. This all supports the author's views as

to the poisonous effect of excessive replacement by sodium ions, and experiments were tried by adding other salts to the sodium chloride solution—magnesium, calcium and potassium chlorides in various combinations and per cents. When calcium and potassium are added the animals live indefinitely; the poisonous effect is entirely counteracted.

Experiments were carried out on the Medusa, Gonionemus, which moves by its rhythmical contractions. Putting this animal into 5/8 per cent. Na Cl solution causes the contractions to cease, but restoration is possible by placing it in normal sea water. Experiments on young larvæ of the sea urchin gave very different results for the effects of ciliary action. The Na Cl solution does not affect that in the same way, and hence indicates that ciliary and embryonic movements cannot be considered of the same nature as muscular; it is much more resistant and less easily modified.

In conclusion, the author summarizes by saying: A pure solution of Na Cl of the same concentration as sea water is poisonous to many, if not all, marine animals. The poisonous effect is due to the Na-ions. The same is true for equimolecular solutions of $Ca\,Cl_2$ and K Cl. The poisonous effects of the Na-ions are antagonized by small amounts of Ca and K-ions. The Na-ions of the blood would not allow tissues to live, but the presence of Ca and K and other ions counteracts the effect of the sodium, thus accounting for the fact that tissues live longer in Kruger's solution than in normal salt. The reason for all these effects of the metallic ions is their chemical union with the proteids of the protoplasm. Muscle is only contractile as long as the three classes of ions are present in certain proportions. The conditions for ciliary motion differ quite widely from those for muscular contraction; this can be maintained for several days in solutions of $Mg\,Cl_2$ and $Ca\,Cl_2$, free from Na-ions. A. M. C.

NORMAL AND PATHOLOGICAL HISTOLOGY.

RICHARD M. PEARCE, M. D.

Harvard Medical School, Boston, Mass., to whom all books and papers on these subjects should be sent for review.

Weysse, Arthur W., Instructor in Biology, Institute of Technology, Boston. An Epitome of Human Histology. Longmans, Green & Co., New York. Pp. 90. Price, cloth, $1.50.

This little treatise of ninety pages, intended for the use of students in connection with lectures and laboratory work, describes the minute normal structure of all parts of the body.

The descriptions are very brief, seldom explanatory, often merely a summary of the structure of a certain organ or tissue. No attempt is made to explain the relation of structure to function. The writer, however, has not allowed brevity to influence the clearness of his descriptions.

Many of the errors of nomenclature frequently seen in more pretentious works on histology have been avoided.

There are no illustrations.

To the student who has finished his lectures and laboratory work in histology

and wishes, with his microscope and sections before him, to briefly review the work of the course, this book will be of value; but, although the writer does not intend it for such, it will probably be used much more frequently by the student who has neglected his work and desires to prepare hurriedly for an examination.

The work of the publisher has been well done.

Schmorl, G. Darstellung feinerer Knockenstructuren. Centralb. f. Allg. Path. u. Path. Anat. 10: 745. 1899.

Schmorl describes two methods for demonstrating the lacunae and canaliculae of bone. They are not true stains, but precipitations of a coloring matter in the lacunae and canaliculae.

FIRST METHOD. 1. *Fixation.* Any of the usual fixatives except corrosive sublimate may be used. The best results were obtained with Muller's fluid, formaldehyde, and Orth's fluid.

2. *Decalcification.* Any method may be used, but the slow methods give the best results. Ebner's method, Thoma's method, 20 per cent. nitric acid in formalin, and 3 per cent. nitric acid in Muller's fluid are recommended.

3. *Embedding.* Celloidin is preferable.

4. *Staining:* 1. Transfer sections from alcohol to water and allow them to remain for at least ten minutes.

2. Stain in either of the following solutions of thionin for five to ten minutes:

   a. Sat. sol. of thionin in 50 per cent. alcohol, 2 parts. Water, 10 parts.

   b. Nicolle's carbolthionin solution.
   1 per cent. carbol water, 90 parts.
   Concentrated sol. thionin in 50 per cent alcohol, 10 parts.

3. Wash in water.

4. Sat. aq. sol. of picric acid one-half to one minute. (This solution should be saturated with the aid of heat and filtered after cooling.)

5. Wash in water.

6. 70 per cent. alcohol for five to ten minutes or until dense clouds of color are no longer given off.

7. Dehydrate in 96 per cent. alcohol.

8. Clear in Oleum Origani Cretici.

9. Xylol balsam.

Bone substance appears yellow to yellow brown; lacunae and canaliculae, dark brown to black; cells, red. Osseous tissue stains a deeper yellow than osteoid tissue. Canaliculae stain in osseous but not in osteoid tissue unless thionin solution is made alkaline by the addition of one to two drops of NH_4OH. (This modification is not recommended for general use).

Fat cells after fixation in Muller's fluid stain reddish violet.

Precipitation takes place to a considerable extent in the marrow spaces and is often confusing. This precipitation can be removed to some extent without injury to the stain by allowing sections to remain in water for half an hour after treatment with picric acid. This modification, however, interferes with

the nuclear stain, and if employed it is well to stain first in alum hematoxylin to bring out the nuclei.

SECOND METHOD. This method gives good results only with bone from children. Only very thin pieces can be used.

1. Harden in Muller's fluid or Orth's fluid followed by Muller's, six to eight weeks at room temperature, or three to four days in the thermostat.
2. Wash in water. Decalcify with Ebner's solution.
3. Wash thoroughly in running water.
4. Harden in alcohol—Embed in celloidin. Cut very thin sections.
5. Stain in Nicolle's carbolthionin, or better in alkaline (NH_4OH) thionin, as given above, for three minutes.
6. Transfer to sat. aq. sol. of phosphotungstic or phosphomolybdic acid for a few seconds. (Glass or platinum needles should be used during this step, as these acids attack steel.)
7. Water, five to ten minutes or until sections acquire a sky blue color.
8. Dilute NH_4OH sol. (1–10) for three to five minutes to fix color.
9. 90 per cent. alcohol, several changes.
10. 96 per cent. alcohol.
11. Clear in carbol xylol. Mount in balsam.

If the ground substance is stained too deeply by the alkaline thionin, treat sections with acid alcohol for five minutes, followed by water before dehydrating.

By this method the borders of the lacunae and canaliculae are bluish black; the ground substance, clear to greenish blue; cellular elements, a diffused blue.

In rachitic bone, the canaliculae are brought out only in the osseous tissue.

NEUROLOGICAL LITERATURE.

Literature for Review should be sent to JOURNAL OF APPLIED MICROSCOPY, Rochester, N. Y.

Blake, Jos. A., M. D. The Roof and Lateral Recesses of the Fourth Ventricle, considered Morphologically and Embryologically. Jour. Comp. Neur., **10**: 79–108, pls. 4–10, 1900.

This paper is an attempt to settle the differences of opinion concerning the metapore or foramen of Magendie, and the foramina of Luschka. In addition to its morphological value, the paper is of importance from its bearing on the treatment of Hydrocephaly. The development of the fourth ventricle in man was followed from early embryonic stages, before the pons flexure, and comparisons made with other vertebrates.

The writer finds that the rhomboidal lips reach a greater development in man than in the lower mammals, and that consequently there is a greater development of nervous matter in the roof of the fourth ventricle and in the walls of the lateral recesses. In Mammalia and Aves a caudal protrusion of the fourth ventricle is formed at some stage in the embryonic life; in man the caudal protrusion becomes lost, giving rise to a metapore, and in all Anthropoidæ there is generally a similar metapore formation.

The view presented being, not that the metapore is merely an aperture in the

roof, but that it is the disappearance of the end of a structure and may be compared with the opening of a shed. From the nature of its origin, its boundaries are not always definable.

The Cercopithecidæ represent an intermediate stage between the Anthropoidæ and the lower mammals in having a tendency toward metapore formation, while in the lower Mammalia the caudal protrusion usually remains closed. The lateral recesses represent an intermediate area shared in equally by cerebellum and oblongata.

In the human embryo there is a well-marked cavity between the *anlage* of the vermis, which is subsequently obliterated by the fusion of the opposite surfaces, and the tent is of later formation and due to the greater proportional growth of the ectal portion of the cerebellar mass.

The rhomboidal lip plays a considerable part in the formation of the acusticum.

For adult forms Van Gieson's stain was found most valuable in differentiating membranes and epithelium. E. M. B.

Argutinsky, P. Eine einfache und zuverlässige Methode Celloidinserien mit Wasser und Eiweiss aufzukleben. Arch. f. Mikr. Anat., **55**: 415–419, 1900.

The method is an adaptation of the albumen fixative method to celloidin sections. The slide is carefully freed from all fatty matter, and a small drop of albumen fixative spread out upon it in a thin, even layer and warmed until melted. Each section as cut is placed in alcohol, carefully unfolded and placed on the slide with a section lifter. Here it is covered with 70 per cent. alcohol and floats out smooth without being stuck to the glass at all. Proceed in this way until all the sections are cut and arranged, being careful to keep them wet with alcohol. If a section should get wrinkled, it may be drawn out with a needle, floated out smooth again in the dish of alcohol, and put back in place. When they are all in position, the alcohol is drawn off with filter paper applied to the edges of the glass, leaving the sections in the fixative, but not stuck down.

To finally fix them in place, a strip of smooth filter paper folded in eight or ten layers is laid over the slide and each section pressed down hard with the finger, whatever alcohol adheres being removed at the same time. The slide is then kept in distilled water or staining solutions as long as desired. Unless brought into a fluid in which albumen is soluble, the sections will remain in position. When the slides are not to be mounted for several days, the sections are better preserved by immersion in 70 per cent. alcohol, instead of water.

NOTE.—Alcohol coagulates albumen, and should serve as an agent to fix the sections to the slide, just as heat does with the paraffin sections. E. M. B.

Tiraboschi, Carlo. Contributo allo Studio della Cellula Nervosa in Alcuni Invertebrati e Specialmente negli Insetti. Boll. del. Soc. Rom. p. Stud. Zool., **8**: 143–150, pls. 1–2, 1899.

This is the last of a series of investigations on the histology of the nervous system in insects, with notes on the neural elements of some of the Crustacea. Hymenoptera examined (Apis, Bombus, Vespa, Formica) showed the chromatic cells, as in Dytiscus, heaped up in great numbers to fill the pedunculate bodies, although in insects there are fewer cells and envelopes than in the pedunculate

bodies of *Limulus polyphemus*. The chromatic cells of the optic ganglion are disposed in a linear series of from ten to twenty cells. The ganglion cells of *Astacus fluviatilis* are more numerous than those of the insects studied.

Experiments made to determine the effects produced upon the nervous system by fasting showed in Blatta, and the larva of *Cnethocampa pityocampa*, that nuclear chomatolysis results from inanition. Larvæ of *C. pityocampa* kept fasting for several days showed chromatin granules changed in size and position, and in some specimens kept fasting for a month, the details of ganglionic structure were indefinite.

Ganglion cells of Dytiscus showed a large number of distinct chromatic spheres, lying peripherally, disposed in a sort of garland, and the nucleoli in Dytiscus and in Hirudo possess a characteristic structure; in the former case consisting of an aggregation of granules, and in the latter being barrel-shaped with dark staining bands across the ends and a light space in the middle.

E. M. B.

Hammar, J. Aug. Ist die Verbindung zwischen den Blastomeren wirklich protoplasmatische und primaer? Arch. f. Mikr. Anat., **55**: 313–335, pl. 19, 1900.

The writer studied the cleavage phenomena of *Echimes miliaris* and *amphidetus*, and makes some additions to what has already been published on the subject of protoplasmic connections between the parts of the segmented egg, The first cleavage furrow arises as an invagination of the outer part of the egg. but in the more central portions it results from a true intraprotoplasmic splitting of the egg substance, and it always retains its intraprotoplasmic character. At the end of the first cleavage there are two primary connections between the blastomeres, a central one effected by the intermediate body, and a peripheral connection formed by the *Grenzsaum*. The first connection usually disappears before the next division, but the second persists. This process is repeated in subsequent divisions. In the fresh egg fine, radial fibers extend between the granular egg plasma and the outer layer, and in fixed eggs fibrils may be seen to extend out from a network, penetrate the outer layer, and fasten themselves to the *Grenzsaum*. Continuity also exists between the substance of the outer layer and the protoplasmic network, and on this account the writer considers that morphologically the outer layer is not a membrane, but ectoplasm, and the connection between the blastomeres is physiologically as living cell protoplasm, not as a membrane.

Hammar's observations on living eggs were not close enough to confirm with certainty the appearances described by G. F. and E. A. Andrews in "Some Spinning Activities of Protoplasm in Starfish and Echimis Eggs," but in sections he found structures corresponding with those described. On the other hand, there are broader bands between contiguous surfaces and distinct borders of connecting protoplasm, which show the continuity of the protoplasm of one cell with that of another. By following sections through a series, he finds that the connection is circumscript rather than ring-shaped.

The polar bodies apparently possess filose activities.

Technique.—The ova were fixed in a concentrated solution of corrosive sublimate in sea water, and sections stained in Heidenhain's iron hæmatoxylin.

E. M. B.

NOTES ON RECENT MINERALOGICAL LITERATURE.

ALFRED J. MOSES AND LEA MCI. LUQUER.

Books and reprints for review should be sent to Alfred J. Moses, Columbia University, New York, N. Y.

Friedel, G., and Cumenge, E. Sur un nouveau mineral d' urane. Bull. Soc. Min., **22**: 26, 1899.

Occurs in powder or loosely agglomerated yellowish masses, intimately mixed with black quartz, and approximating in composition to the formula $2\,U_2O_3$, V_2O_5, K_2O, $3\,H_2O$.

Presence also noted of the "radiant metals" often accompanying uranium.

Found in cavities in sandstone, in Montrose county, Col., associated with azurite and malachite. L. McI. L.

Michel, L. Sur une molybdénite bismuthifère. Bull. Soc. Min., **22**: 29, 1899.

Very close examination shows that the molybdenite lamellæ contain numerous inclusions of bismuthinite. Hence the mineral is a mixture and not a new species. L. McI. L.

Miers, H. A. Mineralogical Notes. Min. Mag., **12**: 111, 1899.

Sphalerite with *metallic* lustre, proved on analysis to be ferriferous, almost exactly corresponding to formula 5 ZnS, FeS.

Zinciferous Galena in distinct, brilliant cubes, gives five per cent. of Zn in molecular proportions, and shows no traces of sphalerite.

Tetartohedral (?) *crystal of Pyrites*, as indicated by faces [111] and [211], on cube corners, being penetrated by a number of parallel and minute subindividuals, forming by their projecting corners a drusy surface.

Author suggests that these are completely interpenetrant twinned crystals of tetartohedral habit.

On some Crystal forms of Lead: a Study in Crystal Measurement.—Etchings of dilute nitric acid on cast lead show drusy surfaces consisting of minute crystals, sometimes cubical, but sometimes of hexagonal outline. Author concludes, from two-circle goniometrical determinations, that the symmetry is cubical, and that the hexagonal outlines are due to the etched surface being nearly at right angles to a cube diagonal.

Author finds it possible, with two-circle goniometer, to obtain accurate measurements from faces almost too small to be visible. This would be impossible by using any other method.

A. Dick is of the opinion (p. 118) that "these crystals have not been developed by the mere etching away of surrounding material, but are deposited as lead crystals from the solvent." L. McI. L.

INDIVIDUAL SPECIES.

Hydromica from New Jersey. F. W. Clarke and N. H. Darton. Am. Jour. Sci., IV, **7**: 365, 1899.

Occurs in minute, matted flakes of golden bronze color. Shows no distinct crystalline form, but optical properties suggest biotite. Fuses to a dark bead.

Analysis proves it to be largely altered to a vermiculite and also very unusual in composition, being very high in ferric oxide, and consisting of muscovitic and phlogopitic molecules in the ratio of 9 : 5.

$$9\ R_3''' (SiO_4)_3\ R'$$
$$5\ R'''\ (SiO_4)_3\ R''_3H_3,\ 3\,aq.$$

Found in veins of calcite, mainly as a thin coating, and next to the diabase walls. L. McI. L.

Kaolins and Fire Clays of Europe and the Clay-working Industry of the U. S. in 1897. H. Ries. XIX Ann. Rept. U. S. Geol. Survey, 1897–98.

Leucite and Analcite, and their mutual relations. C. Klein. Sitzungsber. k. preuss. Ak. Berlin, **16**: 290, 1897.

Apparatus described for heating crystals. Author concludes:

Leucite has rhombic symmetry, very nearly tetragonal, with positive double refraction, and that if it changes its molecular structure at 560°, the new arrangement varies with the three axes, depending on the faces and symmetry of the prevailing form.

Analcite is monoclinic, very nearly tetragonal, with negative double refraction, and in places is isotropic.

The optical anomalies of leucite caused by formation of crystals at high temperature and subsequent molecular changes on cooling; and of analcite by loss of water and changes in temperature and pressure.

Meteorites, Spectrographic Analysis of. W. N. Hartley and H. Ramage. Sci. Proc. Roy. Dub. Soc., **8**: 703, 1898.

Authors have detected the rare element gallium in several iron ores and bauxites.

Gallium found to be present in all meteoric irons, but not in all stones examined. Lines of fourteen elements, common and rare, have been identified.

Meteorite, A new Kansas. H. L. Ward. Am. Jour. Sci., IV, **7**: 233, 1899.

Found in southwest of Ness county. Weight = 417 grams. Complete analysis not yet made.

Meteorites, Average specific gravity of. O. C. Farrington. Jour. of Geol., **5**: 126, 1897.

Average specific gravity of 142 meteorites = 3.69.

Zoizite, Sur une variété de, des schistes métamorphiques des Alpes et sur les propriétés optiques de la zoïzite classique. P. Termier. Bull. Soc. Min., **21**: 148, 1898.

Name zoïzite α used for the first zoisite described by Des Cloizeaux, and characterized by very great dispersion $\rho < \nu$.

Name zoïzite β suggested by author for the crystals differing in optical properties and having dispersion $\rho > \nu$ much less marked than in zoisite α. These often occur in mixtures.

The optical properties of zoisite from different localities are given.

Author concludes that there are two stable forms of $H_2Ca_4\ Al_6Si_6O_{26}$, crystallographically the same but differing in optical properties, and that neither form is strictly orthorhombric, but triclinic, with axes almost orthorhombric.

L. McI. L.

Some reports on the Tasmanian Trachytes, Felsites, and the remarkable "Limurite" rock containing the boric minerals axinite, danburite, etc., have lately been received from Messrs. Twelvetrees and Petterd.

All petrographers will welcome the systematic work being done by these gentlemen on the rocks of Tasmania, and it is of added interest to have such careful determinations and records of rocks from the more remote portions of the world. The micro-photographs of the Tasmanian rock sections are particularly good. The noted occurrence of melilite basalt from the Shannon District is of interest, being the first recorded find of this rare silicate of aluminum and calcium (melilite) in Australasia. The absence of the melilite "peg structure" in this basalt is also worthy of note. L. McI. L.

Journal of Applied Microscopy.

VOLUME III. MAY, 1900. NUMBER 5

MICRO-CHEMICAL ANALYSIS.

V.

GENERAL METHODS AND MANIPULATION OF APPARATUS.

The most important of the operations carried on in micro-chemical analysis can be grouped as follows: 1. *Solution;* 2. *Decantation or filtration;* 3. *Precipitation (addition of reagents);* 4. *Sublimation;* 5. *Determination of crystal angles, optical properties, etc.*

Since it is important that the beginner should be familiar with the methods of performing these operations, and since the present series of articles is written for this class of students and not for those already acquainted with micro-chemical methods, each operation will be discussed in turn in a very brief and elementary manner.

1.—SOLUTION OF THE SUBSTANCE AND TESTS FOR SOLUBILITY.

At the corner of a perfectly clean slide place a small drop of water. Spread it out carefully; it should now be about 3 to 4 mm. in diameter and not over 1 mm. deep at the center. Place, near the drop, a fragment of the material to be examined, about the size of a period on page of JOURNAL. Put the preparation on the stage of microscope and focus on the edge of the drop nearest the fragment of material, using a low power. By means of a glass rod or platinum wire carefully push the material into the drop, at the same time watching, through the microscope, what takes place when the substance being tested enters the water. If, after a few moments, no effect is observed, add 2 or 3 drops of water and heat the large drop gently over the "micro" flame of the Bunsen burner (Fig. 11, p. 795). Since the drop has been placed at the corner of the slide, there is no danger of the glass cracking on heating. Having rapidly raised the temperature almost to boiling, cool quickly by holding for an instant in contact with a smooth metal block placed for this purpose near the burner, or, in the absence of such a contrivance, place the slide on the base of the microscope. When perfectly cold examine carefully, note well the effect of the heating on any of the substance which may remain. The operation of heating to boiling, and cooling, must be rapid; otherwise evaporation to dryness will take place.

To decide whether there is very slight solubility in boiling water, when no action is apparent by the method just given, heat repeatedly on clean, bright,

platinum foil, adding more water if necessary, to replace loss due to evaporation. In treating substances on platinum foil, it will be found convenient to use the corner as directed in the case of glass slides. Remove some of the liquid to the corner of a clean glass slip, by taking off drops with a glass rod or small pipette. Place next to this liquid, a drop of distilled water of approximately the same size. Evaporate both drops to dryness at a low temperature. In evaporating drops to dryness never keep the material over the flame till all the liquid has been driven off. Simply heat the slide, then remove it from the flame and blow gently upon the warm drop, heat again, and again blow; repeat the process as long as any moisture remains. If this method is followed, a uniform, closely adhering film will result, instead of irregularly distributed loose particles. The evaporation of the drops of distilled water by the side of the liquid being tested is for the purpose of ascertaining the purity of the water used, and its action on the glass. The two residues left by the drops must, therefore, be very carefully compared.

It is necessary to again emphasize, in this connection, the fact that it is practically impossible to obtain glass slips upon which even water will not exert a marked solvent action, moreover it must be constantly borne in mind that all solutions of reagents soon take up much foreign matter from the bottles in in which they are kept. Tests for solubility in boiling liquids should always be made on platinum, or on porcelain if platinum cannot be used, and all results checked by comparison with the residues left when the solvent alone, is evaporated. It may be well to add here a warning in regard to the possible absorption of products from the Bunsen burner, chief among which appears to be ammonium sulphate.

Tests for solubility in dilute acids are performed in the manner just described, but strong acids must never be placed on the microscope stage unless precautions are taken to prevent the action of any fumes which might be given off. Strong acids are, therefore, allowed to act, or the mixture is heated, then a portion is removed and evaporated to dryness, and the residue studied.

Minute amounts of material are most conveniently treated on the blade of the platinum spatula (Fig. 6, p. 794).

It sometimes happens that during the heating the fragment of material being tested becomes finely divided; in order, therefore, to obtain a clear liquid for evaporation, filtration must be resorted to.

If the substance is to be analysed, after having found a suitable solvent, a sufficient amount of material is treated on glass, porcelain, or platinum, according to the necessities of the case, care being taken to observe the cautions given above as to impurities in solvents and the probability of their action on the glass of any slides used. This may not always be due to the solvents alone, but may be the result of the action on the glass of the material being tested. When more than one solvent has been found, the choice will, of course, be governed by many circumstances. It is obvious that no fixed directions can be given which will apply to all cases. Much must always be left to the judgment of the operator. It is impossible in an article of the scope of the present one to go into details regarding the preparation of the sample.

2.—DECANTATION.

For most purposes, it is generally possible to obtain sufficiently clear solutions from drops containing precipitates, by drawing off the supernatant liquid without being obliged to resort to the longer and more difficult methods of filtration. Success in drawing off a liquid requires, in the first place, a perfectly clean slide free from grease, otherwise the liquid will not flow properly; and, secondly, patience, care, and a steady hand. The first requirement is met by soaking the glass slides in one of the usual cleaning mixtures and subsequently thoroughly washing them. Sometimes placing a drop or two of ammonium hydroxide on the slide and wiping it dry with a clean cloth will materially improve the surface. The second requisites must be to a certain extent inherent in the operator, but are also largely the result of practice.

Although the phrase synonymous with decantation—drawing off—is self-explanatory and the method is quite obvious, there are, nevertheless, several points upon which the success of the operation depends.

Assuming that the drop of liquid is situated, as usual, at the corner of the slide which is held in a horizontal position, the end of a drawn out glass rod (or a platinum wire) is carefully introduced into the edge of the drop at *a* (see Fig. 14), and is then slowly drawn across the slide in the direction of the arrow; the slide is very gradually inclined at the same time, in the same direction. If the slide is perfectly clean the liquid will follow the rod. When the adjacent corner is reached, the tiny stream is there spread out by a slow, circular motion given to the rod; this induces a flow of the liquid from the original drop. The flow is aided by increasing the angle of inclination, providing, of course, there is no tendency on the part of the sediment to flow with the liquid. The important point, which can only be learnt by practice, is the proper angle and the rate and manner of spreading out the drop. If there is a tendency of the sediment passing over, reduce the angle at once. If the sediment tends to form a dam and prevent the passage of the clear liquid, it is necessary to start a new current at one side of the barrier or to break the latter down at a suitable point. When the proper amount of liquid has been drawn off, still holding the slide inclined, a piece of folded filter or lens paper is drawn through the channel between the two drops at *b* Fig. 15, and the preparation immediately heated gently over the micro-flame at this same point. The result of the heating is the separation of the two drops by a dry space, thus there is no danger of the decanted liquid flowing back when the slide is again placed in a horizontal position. Or, if the liquid is not wanted for subsequent testing, the whole of the clear drop and channel can be removed by filter or lens paper.

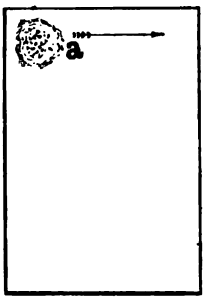

Fig. 14.

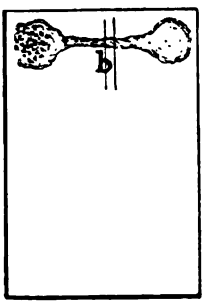

Fig. 15.

In cases where the percipitate in the drop persists in flowing with the solution being drawn off, the drop is first

evaporated to dryness at a low temperature, care being taken to prevent boiling. A few drops of water, or of the proper liquid, are then carefully added and the whole allowed to stand a few seconds, or one can even venture gently warming it. The supernatant liquid can often now be drawn off perfectly clear.

Liquids which have been decanted, but which are not sufficiently clear, can be evaporated and treated by the methods given in the preceding paragraph.

If it is the residue which is of importance, and the decanted liquid is to be rejected, the procedure is naturally the same, but there is then no need for as great care.

Washing residues by decantation can be performed by adding water, or a suitable liquid, warming if necessary, drawing off as just described, adding more water, and repeating as long as it is thought necessary, or until tests applied to the decanted wash water indicate that the washing is complete.

In all cases where decantation is to be practiced, the size of the drop to be treated must be considerably greater than that of an ordinary test drop.

After a little practice it will be found that very satisfactory results can be obtained; and that it will seldom be necessary to have recourse to filtration methods.

DECANTATION BY MEANS OF THE CENTRIFUGE.

Next in importance to the methods above described, for separating sediment from liquid, must be placed the centrifugal machine.

A "two-speed" machine, with hæmatokrit frame, should be purchased, since it is seldom that sufficient liquid is available in ordinary microchemical work to permit of the usual sedimentation tubes being employed. With the hæmatokrit attachment, however, very small quantities of liquid can be handled, and the high speed obtainable will throw out even a precipitate whose specific gravity differs but little from the liquid in which it is suspended.

A convenient form of tube for use at high speeds is shown in section in Fig. 16. An ordinary glass tube of proper size is drawn out to a point in the flame of a blast lamp, and then, by continued heating, the glass is allowed to thicken a little at the end; the end is pressed, while still soft, against a piece of asbestos-board, or a piece of charcoal, to flatten it sufficiently to fit well in the hæmatokrit frame. The tube is then cut the proper length, and the upper end smoothed with a file or rounded in the lamp flame.

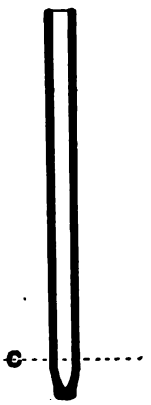

Fig. 16

The turbid liquid to be treated is introduced into the tube by means of a pipette with long capillary end, and placed in the frame; a similar tube is filled with water to the same height, and is placed in the other side as a balance. Thus arranged, the machine is turned at such speed and for such a time as may be necessary to yield a clear liquid.

The treatment to which the sedimentation tube is subjected will depend upon whether the liquid or the sediment (or both) is wanted. When the clear supernatant liquid is required, it is removed by means of a pipette with long capillary tip. But when the precipitate alone is needed the clear liquid is most conveniently removed by capillary tubes made by draw-

ing out odds and ends of glass tubing. With such tubes it is only necessary to touch the liquid, when it is immediately drawn up by capillarity; the tubes filled as far as the force will raise the liquid are thrown away. One tube after another is introduced until the liquid is lowered to a point below the dotted line *C* in Fig. 16. Distilled water is introduced, if the precipitate is to be washed, the contents of the tube mixed well with a platinum wire, and the tube again whirled to effect a separation—for most purposes one washing is sufficient. The wash water is removed as before, and if the amount of sediment is very small, the tube is cut off below the dotted line to enable easy removal of the solid material. The upper part of the tube is not wasted, but serves to make capillary tubes.

These small sedimentation tubes are easily and quickly made. A stock should be provided at odd moments so that a number are always on hand. It will be found convenient to have tubes of different diameters to permit varying amounts of liquid being used. Similarly constructed smaller tubes of thinner wall can be made to fit inside the ordinary "sputum" tubes usually furnished with the centrifuge.

Once having become accustomed to using this instrument, the worker in microchemistry will find that the two-speed centrifuge is an almost indispensable instrument, and will enable him to meet with ease all sorts of problems involving the separation of solids and liquids, which would otherwise tax his patience and ingenuity.

The sedimentation tubes formerly employed, depending upon gravity and time alone to effect a separation, are still in use in some laboratories, but have now really no place on the work table of the progressive analyst. The results are not satisfactory nor can they be obtained with sufficient rapidity.

FILTRATION.

In spite of every precaution it frequently happens that decantation will not yield a sufficiently clear liquid for subsequent reactions, or that the precipitate cannot be freed of the mother liquor, and that centrifugal separation cannot be used. Under such circumstances recourse must be had to filtration, which is doubtless one of the most troublesome processes of microchemical work. Since, in the majority of cases, the amount of liquid to be filtered consists of two or three small drops, often less, methods involving the use of a funnel, be it never so small, are to be regarded as useless: in this category must be placed the ingenious filtering device of Haushofer,† for it is too cumbersome, complicated, requires too much time, and necessitates the transfering of the solution from the slide to the filtering apparatus.

Of the filtration methods without apparatus, the best is undoubtedly that of Streng as modified by Behrens, which is thus described by the latter:* "The filtering-paper is cut in the form of a Y, two of the branches are put on a clean slide and affixed to it with a drop of water, the third branch is bent downwards till it touches another slide placed beside the first one, but somewhat lower; finally the liquid that is to be filtered is put on the upper slide, in contact with

† Haushofer, Mikroskopische Reactionen, p. 160.
* Microchemical Analysis, p. 20.

the forked end of the strip of paper." Behrens gives the dimensions of the strip of filtering-paper as 1 mm. in breadth by 10 mm. long. The upper slide must be slightly inclined to favor the flow of the liquid. At its best the method is tedious, requires great care, and is unsatisfactory.

This same investigator has recently devised a much more convenient and practical method by employing a filtering tube, see Fig. 9, p. 795. Filtration by means of this apparatus is performed as follows: a rectangular piece of thick soft filter paper of close texture is cut slightly larger than the diameter of the tube, and placed on the slide close to the drop to be filtered; the ground end of the tube is pressed firmly against the filter paper near one edge, the whole is then moved slowly into the drop; as soon as the paper is wet, gentle suction is applied to the upper end of the tube by the mouth, either directly, or through the agency of a rubber tube. At the same time the filter paper is slowly advanced still further into the drop, the precipitate, unless exceedingly fine, will be pushed along in a ridge before the advancing paper. By reason of the suction the clear liquid rises in the tube. If there is insufficient liquid to thoroughly moisten the paper and to rise partly in the tube, it is necessary to add a drop or two of distilled water to the drop being filtered. When sufficient liquid has been drawn up into the filtering tube, the latter is pressed firmly against the slide, suction discontinued, and a finger placed promptly upon the upper end to prevent the contents flowing out. The tube can then be lifted off the slide. To remove the filtrate it is only necessary to bring the ground end of the tube in contact with a clean slide and remove the finger from the upper end; the filtrate generally flows out at once. If it does not, a slight breath applied to the upper end will drive out the liquid. The most important points to be learnt are the proper amount of pressure on the filter-paper, the rate at which it is safe to advance the paper into the drop, and the amount of suction to be applied to the tube.

The writer has been using for some time a modification of the filtering tube just described*; this change was made in an endeavor to overcome two difficulties encountered in rapid work with the original Behrens tube, (1) the danger of carrying the filtrate up into the mouth or into the rubber tube by air bubbles, which are always drawn into the tube when the liquid to be filtered has all been absorbed by the filter paper and sucked into the tube, and (2) it not infrequently happens that the filtered liquid begins to flow out when suction is stopped, before there is time to prevent it by closing the upper end of the tube. This filtering device (see Fig. 17) consists of a glass tube provided with an inner tube or trap, and a thickened lower end with only a small opening. A glass tube about 3½ mm. internal diameter has fused into its vertical axis a tiny tube about 1 mm. in diameter and 7 to 8 mm. long. The lower end of the main tube is caused to flow together until the central opening is about

Fig. 17.

* Since this manuscript was written, G. H. Savage has described, in the January number of this journal, page 678, a filter for microchemical analysis which is practically identical with that of Dr. Behrens, the difference being in the manner of applying the filtering medium. In some respects the Savage system is an improvement on the older one. It has been tried by the writer and found to be convenient and to give very satisfactory results.

2 mm. in diameter, and it is then ground so as to give a perfectly flat surface. The apparatus, which is 30 mm. long, is attached to a rubber tube and is employed in the same manner as the previously described filter-tube. It is obvious that as the filtrate rises in the tube it overflows the small trap and is held in the space between the walls of the outer and inner tubes. The tube through which the liquid rises is therefore free, and any air bubbles entering cannot cause a loss of the filtrate, nor can the liquid flow back if suction is stopped. The filtrate can be removed either by means of a drawn-out pipette or by inverting the tube and inducing the liquid to flow by means of a platinum wire. This filtering tube has proved quite satisfactory and can be made in a few minutes with a blast lamp by anyone accustomed to ordinary laboratory glass blowing. It is not, however, by any means perfect; its chief defect I have found to be the difficulty of properly cleaning it unless promptly emptied and rinsed. When the tube is washed out immediately no trouble is experienced.

3.—PRECIPITATION AND ADDITION OF REAGENTS.

Precipitation as understood in ordinary chemical analysis can seldom be employed to advantage in microchemical investigations. Crystallization would, perhaps, be a more exact term. Since, however, the microchemical reaction produced by the addition of a reagent to a solution of the substance to be tested, resulting in the more or less rapid formation of a characteristic crystalline deposit, corresponds to the precipitates obtained in ordinary qualitative analysis in the wet way, the term has been here retained.

Satisfactory microchemical reactions should result in the formation of well defined crystals. It is seldom that an amorphous precipitate, even though it be colored, can be used to advantage. It follows, therefore, that in the choice of reactions those leading to the formation of very insoluble compounds are generally to be avoided; while those yielding more soluble products tending to build up bulky molecules and giving large, well developed, and easily recognized crystal forms, will be chosen.

The formation of neat, well formed crystals depends upon many conditions, prominent among them being concentration, temperature, relative acidity or alkalinity, time, etc. Consequently different tests, which involve different reactions, require a variation of conditions in order to obtain the best results, and success in microchemical methods of analysis will depend as much on careful attention to the little details as to conditions, on the part of the operator, as ability on his part to remember and distinguish crystal forms.

There is still another feature to be considered; tests to be really satisfactory must not require too much time. Hence a reaction leading to the formation of rather poor crystals in a few seconds or minutes will be employed, rather than one giving better results but requiring several hours.

Detailed directions can, of course, only be given in a discussion of each test, but a few remarks of a general nature are possible at this point.

Solutions to be tested are always, unless otherwise directed, placed at the corner of a slide in order that the material may be subjected to considerable heating if necessary; to facilitate the easy removal of either the whole test drop or of tiny fractions thereof; and to permit of decantation, if required.

Reactions requiring a nice adjustment of concentration or leading to the formation of very soluble compounds, thus entailing a considerable loss of time were much liquid present, are always best performed on the dry residue. A residue for such a reaction should consist of a thin, uniform film of material, and is to be obtained only when scrupulously clean slides are employed, when a small amount of the substance is present, and when care is taken to avoid heating too hot during the evaporation. Gentle heating and blowing on the warm drop will give the best results. In cases where a ridge of the solid material tends to form around the edge, as is the case if too much substance has been used, it is advisable to remove this ridge by means of the platinum spatula (Fig. 6, p. 794), using it shovel-wise. The reagent is dissolved in a tiny drop of water placed just beside the dried test drop, and is then drawn across the latter with a quick stroke of a glass rod with drawn-out end, care being taken to avoid touching the slide in leading the reagent across. The slide should also be inclined a trifle in the direction the liquid is being drawn, to facilitate the flow. The solution should never spread over the entire film of substance, but should remain as a streak of liquid dividing the dry spot in half. When the liquid completely covers the residue, it is usually due to one or more of several causes: too thick a film; a slide which is not clean; heating after the residue was dry and so detaching it from the glass; too much reagent, etc.

Reactions giving rise to the rapid formation of compounds of low solubility are ordinarily best obtained by placing a drop of the reagent close beside the drop of the solution to be tested and causing the two drops to flow together. The two drops should be so close together that a glass rod can be made to touch the edge of each when it is placed between them. It is advisable to avoid mixing the drops. Mixing is apt to produce poor results. The union of the drops should therefore take place only at one point. Both drops should be dilute.

Reactions involving none of the above described cases can be performed by adding a fragment of the solid reagent (or a drop, if a liquid) directly to the test drop near the edge. When compounds are formed which are decidedly soluble in an excess of the reagent, great care is necessary to prevent a failure due to too much reagent. It is well in such cases to start with mere traces.

Reagents are always added by means of glass rods or platinum wires. It is an excellent plan never to employ pipettes, for not only are the drops delivered too large, but the pipettes are not easily cleaned. Touching the tip of a rod or wire to a finger will almost always moisten it sufficiently to cause it to pick up tiny fragments of reagents. Immediately after being used, rods, wires, or pipettes should be dipped into distilled water. A vessel for this purpose should always be on the work table.

In cases where there is danger of too rapid formation of crystals a little acetic acid will often accomplish wonders; sometimes a strong acid such as a trace of nitric acid may be necessary. Glycerine, acting by preventing evaporation and so retarding the growth of crystals, may also prove valuable.

Hastening the separation of a compound can be accomplished many times by subjecting the test drop to vapors of alcohol or by the direct addition of this substance. "Salting-out" can also be practiced in cases where the addition of

a relatively large amount of a suitable ammonium (or sodium) salt will not interfere with future tests.

Recrystallization of minute amounts of material is best accomplished by breathing on the preparation until sufficient moisture has condensed on the spot.

4.—SUBLIMATION.

This operation, though of somewhat limited application and seldom employed in inorganic qualitative analysis, is so very important, and of such inestimable value in the examination of organic compounds, that every worker should become thoroughly familiar with it, particularly with the method of performing fractional sublimations.

The usual method is that of sublimation from one slide to another. The material to be tested is placed at the corner of a *thin* slide. If it is a solid it is wise to moisten it with water and then dry it thoroughly; this will generally effectually prevent the material from being blown off by air currents, and brings the substance in intimate contact with the glass slip, a matter of prime importance. If the material is already in solution, evaporate a tiny drop, but in this case it should not be spread out, as is commonly done with test drops. When the drop is dry add another tiny drop on top of the residue left by the first, this in turn is dried, the process being repeated until, in the judgment of the operator, there is sufficient material for work. In all cases the residue to be treated should occupy but little space, yet should not be too thick, since if fractional sublimation is to be practiced a thick mass is apt to be heated unequally and fallacious results will be obtained.

Everything being ready, the slide is held in the left hand and the heating begun over the "micro-" flame, not beneath the spot of material, but slightly nearer the center of the slide. This is done in order to avoid raising the temperature too rapidly and too high. As soon as the sublimation point is almost reached (which can soon be recognized by practice) a second clean slide, carrying a drop or two of water, is taken in the right hand and lowered over the first slip, with the drop of water on the upper side and situated directly over the material to be sublimed. The drop of water has for its object the keeping of the upper slip cool, thus more effectually condensing any vapors produced by the heating. The receiving slip is supported on an edge of the other and is brought to within 2 to 4 mm. of the substance (see diagram, Fig. 18). The temperature is gradually raised by moving the spot of substance nearer the flame. As soon as there is evidence of the appearance of a sublimate, raise the two slides above the flame so as to prevent too rapid vaporization. The first deposit being obtained, the receiving slip is moved along a few millimeters and a second sublimation made; again the slides are partly moved from the source of heat, the receiving slip moved along a trifle, and again

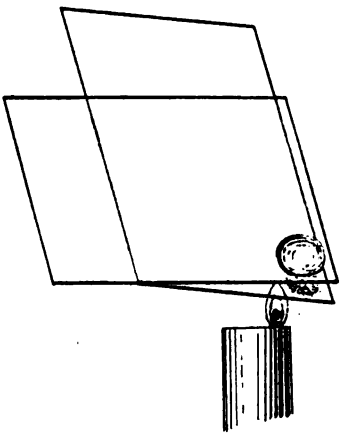

Fig. 18.

the temperature is raised until a third film has been condensed. The process is continued as long as the material holds out on the first slide or fails to yield any further sublimate. If the drops of water used to keep the receiver cool, evaporate, replace them by others. When dealing with compounds which melt on heating, the supporting slide must be slightly inclined so as to keep the material at the corner of the slip.

It sometimes happens that a more crystalline and characteristic sublimation film is to be obtained when the receiving slide is slightly warm; in which event the water is omitted, or, if this is not sufficient, a little cylinder made of carbon such as is used in arc lamps is warmed over a burner and placed on the slide. Such pieces of carbon remain warm for some time and will be found to give excellent results.

Sublimation from a metallic support is resorted to if it is believed that the temperature cannot be readily raised to the proper point with glass slides. Nickel or platinum are the most serviceable supports; in either case the most convenient form will be like the platinum spatula already mentioned. The material is placed on the blade, moistened with water in order to insure intimate contact, dried, and heated for sublimation at a little distance from the residue. The receiver consists, as before, of a glass slip, either with or without water on its upper surface. The first deposit is received at the corner, after which the slide is moved along, as has just been described. During the heating the receiver is allowed to rest against the metal, in a similar manner to that shown in the diagram. Platinum foil can also be employed, either as a support or as a receiving surface, or both, the manipulation being the same as for glass slips.

In inorganic analysis it is generally the chlorides or oxides of the metals which are tested by sublimation. When the former, the material is moistened from time to time with strong hydrochloric acid, dried and heated; when the latter, conversion into nitrates is first practiced by heating with strong nitric acid; the nitrates are converted into oxides, and part of these in turn vaporized by raising the temperature.

Cases requiring a determination of the temperature of sublimation not infrequently arise. The method recommended by A. W. Blyth may then be employed. A small porcelain crucible is nearly filled with mercury, into which dips the bulb of a thermometer. A thin cover-glass, bearing at its center the material to be tested, moistened and dried as usual, is floated on the surface of the mercury. Upon the cover-glass is placed a low glass cell whose upper and lower rims are accurately ground. A second cover-glass is placed above to receive the film—see diagram, Fig. 19. A number of clean covers should be placed near at hand. The crucible is heated over the low flame of a Bunsen burner. As the temperature rises, the covers are changed, by means of a pair of forceps, every five or ten degrees. The cover-glasses are examined under the microscope, and a decision made as to the temperature of sublimation. A second or even a third experiment should

Fig. 19

always be made. If the material fails to sublime at a temperature below that at which the mercury itself is volatilized, a bath of a suitable low-melting alloy must be used.

The author employs a method similar in principle. A rectangular block of copper, having a small well bored near one end, has its upper surface perfectly flat. The well is filled with mercury or fusible metal, into which the thermometer dips. The cover-glass, bearing the substance to be examined, rests upon the polished surface of the copper block. The method of using the apparatus is the same as given above. Among the advantages gained are: (1) there is no danger of the mercury, or of oxides from the alloy bath, condensing on the receiving cover; (2) there is no vessel to break and thus spill the molten metal; (3) covers are more easily changed.

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Biology in Secondary Schools.

One of the most important problems before educators to-day is the readjustment of the school curriculum. Never in the history of education has there been greater mental activity than now. Old methods are giving way to new and better ones. This is in accordance with the law of adaptation, and existing schemes of education must be modified to meet the rapidly changing conditions. Nowhere is this more apparent than in the sciences.

That scientific thought is working its way to the front in modern systems of education is highly significant. The ultra-conservatism of education is giving way to a fuller recognition of other mutually helpful educational forces. There is an important work, embodying the fundamental principles of scientific investigation, which should fill up the great gap between the kindergarten and the progressive college or university. Therein lies a great field of resources which when developed will be sure to enhance the value of general education.

To-day marks a period of transition and expansion; and already we see signs of marked improvement in the elementary and secondary instruction in the sciences which has been so long kept in the background. There is thus a natural and progressive demand for a preparatory course in the natural sciences, that shall be more representative of natural phenomena and at the same time be of great value to the student. This, the colleges and universities are beginning to recognize in the work of secondary schools. Such a course would not only be of inestimable value in the way of discipline to the preparatory student, but it would also furnish a solid foundation for the science work later on.

The time has come when the eyes of pupils should be turned toward the most natural sources of knowledge and the most stimulating methods of inquiry. Instead of the hum-drum of partial payments, of roots square and cube, of the endless memorizing of geographical names, and the whole category of rhetorical figures, we shall have a new field, rich in data for composition work, fascinating and productive in all the realms of matter—of forces chemical and physical, of forms both living and non-living.

When now we come to consider the problems which confront us in secondary schools we find it is still an open question as to what are the relative merits of the different sciences, their order of arrangement in a curriculum, and their methods of presentation. With all the prevailing differences of opinion among educators there should be recognized by all some very important things, namely, (1) a uniform course of study, (2) a course that is pedagogical, (3) one that is for the good of the pupil, and (4) one that is adapted to the wants of the many.

Again, it should be emphasized that the sole purpose of secondary schools is not to prepare students for the higher institutions of learning, because so few ever attend college, but rather it should be their function to give a rational conception of nature, of the relations and significance of everyday problems, in short, to produce the best type of citizenship.

Just at this point in these very preliminary statements, before entering into the discussion of the biological and physical sciences, it might be well to recall what part in the rôle *nature study* should play in a well-balanced science course, and, briefly, what should be the *modus operandi* to accomplish the best results. Science work in the preparatory schools should presuppose nature work in the grades, and also some instruction in physical and chemical phenomena, which in no small degree would lay a good foundation for the higher work to follow.

What is nature study? It is the proper interpretation of what one sees around him. It is not a science, for it includes the systematic classification of things. It is more or less informal and general, free from definition and abstract explanations. It deals with things supremely natural. It seeks, therefore, to cultivate the observational powers, to train the mind to comprehend familiar things, to acquire power in overcoming the more intricate problems of life, in short, to contribute to our general welfare and put us in touch and sympathy with all the things of creation.

What should be the field of inquiry? The world's great farm. Objects of peculiar interest await us on every hand. It may be a pebble, or it may be a bird, a beetle, a butterfly, a bud, a flower, a toadstool. The best results of nature work cannot come from the data of books. It must come from nature itself, and for this reason the methods of study should largely be experimental. The purpose of the work is not so much to gain direct and scientific information about things as to train (1) the eyes to see, (2) the mind to express, (3) the hands to represent.

Nature study is the royal road to learning. The chief obstacle in acquiring it lies not in the difficulty of the subject, but in the method of application. So far but few teachers seem to be able to properly draw out the keenly perceptive powers of the child. But, sooner or later, the teacher will be equipped and thoroughly awakened and alive to all the interesting phenomena about him. To make the work successful a teacher need not be a scientist, but he should be able to interest pupils in common objects, and set them to thinking and investigating for themselves. Knowledge is not the peculiar property of the few, but the common heritage of all who seek it.

The general principles upon which nature study depends may be summarized as follows:

1. The work should not form a definite part of the program. There should

be no formality as to the time, kind, and amount of work. This would be irksome. Let it be a period of recreation, when vigor and energy are gained for other work.

2. The exercise should never be long, but not less than fifteen minutes daily. The amount of time spent upon an object should vary with its characteristics, the ingenuity of the teacher, and the interest of the pupils.

3. Those things only should be studied which are the most familiar and which present themselves under the most favorable conditions.

4. In the main pupils should collect their own material. It should be the pupil's exercise and not the teacher's, though the teacher should direct the way.

5. The method of presentation should be, without doubt, oral. Good English expression should obtain at all hazards. Teachers should insist on asking questions till the subject is well rounded out.

6. Pupils should make reports of their observations, write compositions, and make drawings illustrating the chief points of interest.

7. Pupils at all times should be taught to see with their own eyes, handle with their own fingers, and deduce their own conclusions.

8. To make the work successful, teachers should interest and secure the hearty coöperation of parents. There should be no effort on the teacher's part to abuse the amount of time nor to exact an unreasonable amount of money for the good of the work.

9. The teacher should take frequent rambles in the woods, fields, and meadows to study the various kinds of landscape with its teeming life forms. The work should never become monotonous nor perfunctory.

10. The order of presentation of subjects or objects cannot be uniform, because each locality has its own peculiar environment. Take the things which appeal to the child most interestingly and sympathetically—it may be a plant, or an animal, or a rock. Children should be taught that plants and animals beautify and supplement each other. The life relations of things should be studied more than any other phase and just enough of structure to make the life-relations clear. The work should consist mainly of gross anatomy, aided possibly by a few simple lenses.

11. Popular literature may now be had from most of the agricultural colleges for the asking, also from many of the larger book concerns.

Turning aside, now, from the path of nature study, let us strike out into another bypath which includes the biological and physical sciences, and point out, very briefly, their more salient features. There will be no attempt, however, to outline a great scheme into which all these included subjects exactly fit. Nor is it the purpose by the proposed order of presentation to express any opinion as to their relative importance. Each subject has its own peculiar value in an educational system. In most cases the existing conditions in our secondary schools make it the most reasonable and substantial arrangement. It is not intended to be inflexible and iron-clad in any sense, like that which used to fashion men and things in a common mold.

FOUR YEARS SCIENCE COURSE IN SECONDARY SCHOOLS.

First year	Second year	Third year	Fourth year
Botany and Zoölogy or Botany or Zoölogy	Botany or Zoölogy and Physiology	Physics and Chemistry or Physics or Chemistry	Physics or Chemistry and Physical Geography

The principles involved in the preceding table may be summarized as follows:

1. Not less than four years should be devoted to science work in our secondary schools; and the time required to do effective work should be relatively equal to the non-laboratory subjects.

2. Long and thorough courses in one branch are preferable to the study of many branches superficially. The best training and most useful knowledge come from long periods of thorough and well directed work.

3. Let the first year and a half of the course be devoted to biology, either botany or zoölogy, or both, and the last half of the second year to physiology.

It is believed by those who are competent to judge that the study of plants should introduce the work of the sciences. Plants are always with us, and are easily obtained and preserved. It may be that botany, as a rule, appeals more to our daily interests, and from the standpoint of æsthetics the plant world surpasses the animal. Educationally, botany and zoölogy are of about equal value, but the order suggested is the more commonly used.

Again, it is thought to be the more feasible plan not to combine these two subjects under the guise of biology, but rather to pursue them separately. The amount of time given each subject should be determined by the instructor in charge. More time should be given to that branch in which the teacher is best trained and the laboratory best equipped. If the conditions seem to warrant it, it might be well to use all the time in the one or the other subject, because the discipline in both is more or less duplicated.

The course in physiology should be governed by what has been done in the grades below. As it is difficult to bring students into actual contact with its phenomena, it should be treated as an informational study, and has no place among the laboratory sciences. Among other things it should emphasize practical hygiene and human economy.

4. The physical sciences should follow the biological, and to physics and chemistry, in the order named, should be given one and a half years. Physics, no doubt, is the more important of the two, and the more successfully taught in our secondary schools, hence it should receive more prominence. Yet it might be advisable, in some schools, to reverse the order, but this would be rather unfortunate.

After the physical sciences should come physical geography, with one-half year. It is the marrow of all the sciences, because it rounds them all out and puts on the finishing touches. It, too, is more or less an informational subject and should not be based on the laboratory plan, though it should be broad in generalizations, inferences, and deductions.

5. It is needless to say that the bulk of the work in the biological and physical sciences should be on the laboratory plan. The touchstone of scientific work is the field and laboratory. Any other method of scientific teaching is unworthy the name of science and has no value in scientific training.

6. If the program of studies will not admit such an extended science course, then let there be but two years of the biological and physical sciences—one year in either botany or zoölogy and one year in physics or chemistry, preferably physics. Nothing but *one* year in any science subject should count. Less time is a waste of energy.

In the further discussion of this subject it is my purpose to present briefly my idea of a practical course in biology, mainly from the standpoint of plants. Of the many elements which enter into the success of the work, three deserve special mention :

1. *That the teacher be thoroughly trained and in sympathy with the work.*—As to the methods of teaching botany in secondary schools, they are very diverse. There is no universal best method. In this as in other branches the most successful teaching depends more upon the teacher than the methods employed. Each teacher has his own best method. But a few requirements, at least, are necessary in order to do effective work in the teaching of botany. First of all, the teacher should be thoroughly trained to what he proposes to do. He should bear the earmarks of a determined worker, and he should be a student. In view of the many excellent universities and summer schools, some of which are within the means of all, there is no valid excuse for not securing skillfully trained men in all the departments of science in all grades of educational work. Success in the work depends so much upon him who is to be leader—a leadership that is born of sound pedagogic sense—a leadership that arouses interest and enthusiasm, that directs the mind from ignorance to knowledge, and that becomes lost in the student's mental welfare.

II. *That the subject be pursued mainly from the standpoint of field and laboratory.*—To realize the full value of biological training the student must come in contact with the subject-matter itself. Botany is not a book; neither is it a study of books, but it is a study of the world of plant life. It is a science involving the evolution of the plant kingdom. It is the study of life in all of its relations to matter.

Stimulated by the desire of discovering the original sources of knowledge, the student is led to experiment with the very heart of nature, and thus he acquires the investigating habit and the scientific spirit that develops greater strength of mind and force of character. It puts the student in sympathy with the natural, independent, inductive process of thinking—a process which becomes the true basis of scientific progress. It places him in touch with those very problems in which the student himself is vitally concerned, and intensifies his interest in living things.

III. *The kinds of botany that would be the most beneficial in our secondary schools.*—Formerly but one corner of the botanical field was studied, namely, the gross anatomy of flowering plants. It consisted chiefly of the "analysis" of flowers and the mounting of a half hundred plants. It is unfortunate that in a

great many places it is not yet recognized that this practice has (entirely) outlived its usefulness. Following this came the laboratory method with its various equipments. The simpler forms of plant life, as well as the higher, were next considered. But, unfortunately, it led to the almost exclusive study of microscopic structures. Plant structure and morphology now became the other extreme. In the one case we had the systematist, in the other, the morphologist, either of whom had but a vague notion of botany as a living science. To-day the pendulum is swinging nearer a happier mean, and we have the correlation of familiarized facts, worked out by the two schools, combined in a third which recognizes that a plant is a living, working thing, possessed of organs that sustain certain life-relations to its environment. This seems to be the most natural way of approaching the plant world, in which form, structure, and life itself are perfectly adjusted.

This new phase does not undervalue or banish the work of the systematist and the morphologist, but gives in connection with them a much broader perspective to the plant as an individual organism. They supplement and throw light upon one another. This is in harmony with the fact that the subject should be presented synthetically if the best results are to be realized. The synthesis embraces anatomy, morphology, physiology, ecology, and plant classification. The forces and influences at work upon plants are directly related to their structures. Physiology is the basis of anatomy, while ecology is the basis of morphology, and from the observations of physiology and ecology we have a new conception of the plant, that it is a living, breathing, working life-form.

To introduce the subject of botany, therefore, in a fairly well equipped laboratory, I would suggest for Course I, study along the following lines: Seeds, their germination and dissemination, stems, roots, leaves, morphology, classification, and finally the light-and-life relations of the so-called plant organs, namely, root, stem, and leaf. This leads the student to experiment with the life-processes, such as photosynthesis, respiration, absorption, transpiration, etc. Nothing is simpler and more fascinating than to improvise such apparatus in the laboratory as will explain the life-processes and at the same time serve the purpose of supplementing the larger observations frequently made in the field. As a condition to this course, there should be individual work, two laboratory periods of two hours each, at least, oftener if possible, and two forty-minute periods for quizzing, lecturing, etc. Accurate drawings should be made of all observations. The best reference books ought to be accessible to students, but nothing should be put into their hands for a daily guide save laboratory directions, but the latter must be interpreted by a wide-awake teacher. This course should cover at least a half year's work.

Course II. The remaining half year or whole year, in case zoölogy is omitted, can be very profitably spent upon some of the lower forms as well as the higher. It may embrace the following: algæ, fungi (molds, rusts, smuts, blights, mildews, mushrooms, etc.), mosses, liverworts, ferns, pines, etc. These forms, whether all worked or not, should be presented from the standpoint of plant-evolution. They should be approached and studied in such a way as to present a comprehensive whole. Greater value is attached to the comprehensive study

of all the groups rather than a comprehensive study of a few forms. To be able to recognize the main plant groups and their place in nature is the object of this course. This phase of botany would necessitate the purchase of compound microscopes and simpler accessories, which now can be purchased at reasonable prices. This course should be pursued in much the same way as Course I.

With reference to the study of animal life it is safe to say that nearly the same plan of procedure can be followed as in botany. The phenomena of life are so similar and complementary that about the same problems are involved and the same conclusions reached.

In this science as in plant life the proper perspective and most significant results cannot be secured without a thorough laboratory and field training. Information *about* animals acquired solely through text-books leads to no real knowledge of animal life as it exists in nature, but becomes a substitute for the thing itself.

As to the forms for study, the field is so enormous that the question arises what phases of it may be most profitably presented. A careful study should be made of a limited series of types,—animals which represent the most prominent groups and phases of development. If a haphazard selection of material is made, the work is sterile and the facts incoherent.

To obtain a conception of animal life as a whole is the chief desideratum, and to secure this a general survey should first be made, not by taking a superficial view of life-forms, but by coming into actual contact with them. The choice of types must be in accordance with the available material, but at least one thing is requisite,—an orderly succession of related forms. The habit of drenching students with material and facts which have no more logical relation to one another than the words of a dictionary, cannot be too strongly condemned. The work if not presented in proper sequence represents nothing when done, and besides, so much energy lost. To introduce the subject it matters not what group of animals is first studied, the invertebrates or vertebrates. In harmony with psychological laws it is better to go from the known to the unknown. In one locality it might be well to select an insect or crustacean, in another, a bird or mammal, the choice in each case depending upon many varying conditions, such as the needs of students and the familiarity and availability of material. Hitherto too much emphasis has been placed upon taxonomy, which has some value in cultivating the faculty of observation and in training the powers of discrimination and analysis, but it does not give an adequate impression of the animal kingdom and fails to develop fundamental biological principles. Aside from systematic work, there should be more of comparative morphology and general physiology. Structure and function go hand in hand. More attention should be paid to habits, economic interests, life-activities, and the life-histories of animals. The information that is gained by contact with living specimens,—that they hold definite relations to light, heat, gravity, and plant organisms, gives a broader view and a deeper insight into the secrets of nature than that which comes exclusively from the reading of books. Field excursions, simple physiological experiments, accurate drawings, recording of notes, collateral reading, especially the records of great naturalists and explorers, all combine to add interest and enthusiasm for the work.

Although the above principles are set forth in the interest of higher education, they will not, perhaps, meet universal recognition in our secondary schools. Much of the old curriculum will have to be gradually displaced by new features, and in proportion as training and familiarity with the newer methods grow, the incongruities of the old will disappear. And when we have an educational policy that considers not so much the feeling of the teacher as the good of the pupil, there will prevail a unified system of education which will develop in the student the power to adapt himself to the sphere for which the Infinite created him.

GEO. W. MARTIN.

Adjunct Professor Biology, Vanderbilt University.

LABORATORY PHOTOGRAPHY.

Devoted to methods and apparatus for converting an object into an illustration.

THE PHOTO-MICROGRAPHIC ROOM AND APPARATUS IN THE ANATOMICAL LABORATORY OF THE JOHNS HOPKINS UNIVERSITY.*

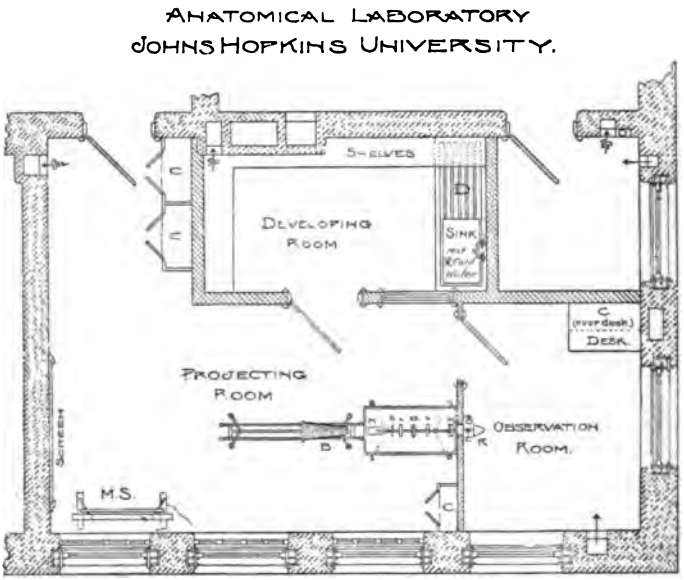

FIG. 1.

C, Cases. D, Drip-board. MS, Movable screen. B, Bellows. M, Microscope. S, Specimen holder. L, Light filter. ss, Double convex lens. s, Plano-convex lens. H, Heat filter. *, Electric light. R, Reflector.

The scope of photo-micrography can conveniently be divided into photo-micrography (1) with high powers, (2) with medium powers, and (3) with low powers.

(1). Photo-micrography with high amplification (600 to 1200 diameters) is

* A. G. Hoen, M. D., In The Johns Hopkins Hospital Bulletin, Nos. 62–63, May, June, 1896.

SOUTH-WEST CORNER OF PROJECTING ROOM.

employed chiefly for the study of micro-organisms and fine histological structures.

(2). Photo-micrography with medium amplification (150 to 400 diameters) is applied to tissue work, where it is desirable to differentiate structural elements in pathological as well as in normal histological material, micro-urinary deposits, and the study of vital movements (amœboid) of certain cells by serial exposures.

(3). Photo-micrography with low powers (1–100 diameters) is applied in the study of various tissues with reference to their anatomical relations, and for injected specimens of whole organs.

It was with the above uses of photo-micrography in mind that the rooms and apparatus, described in this paper, were constructed and purchased. As seen in the plan, there are three rooms. The main room (Projecting room), is made perfectly dark by being painted dull, or flat black, and having the windows protected against the admission of light by three sets of blinds, Venetian blinds on the outside, an adjustable black cloth blind on the inside, and over these, sliding paneled wooden blinds. It contains the tables carrying the condensors, microscope, camera, and the projecting apparatus consisting of a perfectly smooth plaster of Paris screen on the wall directly behind the camera, and a small movable screen.

The second room contains all necessary chemicals and water supply for developing plates, and conducting such other manipulations as appertain to photography. It is lighted by incandescent lamps, one of which, for photographic purposes, is hooded with black velvet over a frame of asbestos, and covered on the lower side by three thicknesses of deep ruby glass.

HELIOS ELECTRIC LAMP.

The smallest room (Observatory room) is well lighted, and contains a 4000 candle-power electric arc, the light from which is projected by a paraboloid reflector through an aperture in the partition into the apparatus in the large room. The arc lamp is mounted on a mechanical stage, attached to the partition, which admits of vertical and lateral movements, so that it may be adjusted easily to the optical axis of the photo-micrographic apparatus. The carbon holders are balanced by means of a chain over a pulley in the lamp mechanism, the result of which arrangement with alternating current is that the combustion of the carbons is compensated by the descent of the upper and the ascent of the lower carbon in exactly the same ratio, and the arc is thus fixed practically at one point, remaining there from the time the current is turned on until the carbons are consumed. To overcome the considerable vibration of the carbon points,

an adjustable guard is attached to the side of the lamp, to steady the upright rod of the lower carbon point.

The photo-micrographic apparatus consists of a special microscope stand with 2, 2.5, 4, 8, 16, 35, and 70 mm. lenses, and Nos. 2 and 4 projection oculars. In addition to these are the following photographic lenses, which can be used for photographing with low powers, as well as for ordinary lantern projection:

Anastigmat	1: 6.3,	focus	43	millimeters.
"	1: 7.2,	"	96	"
"	1: 7.2,	"	148	"
"	1: 12.5,	"	260	"
"	1: 18. ,	"	632	"

Besides these lenses, there is a complete projection table with its appendages, as well as the large camera. For delicate work there is a spectral illuminating apparatus after Hartnack. The anastigmat lenses are all interchangeable, and the large ones are fitted with a prism to photograph at right angles to the object, as is often necessary in photographing objects under fluids. An achromatic Abbé condenser is used, which, being supplied with two iris diaphragms, permits the use of entire aperture of the condenser, or only a fractional portion thereof.

As a means of bringing the two tables to an exact level, that the optical axis may be perfect, set screws are put into each of the iron pedestals of the table; these screws, resting in small metallic discs, which are simply laid on the floor in their proper position.

Two methods of illumination for high and medium powers are practicable. The first may be illustrated from Fig. 1. The rays from the arc light (*) are received upon the plano-convex lens x, which is so placed that the arc is in its principal focus, thus rendering all rays passing through it, parallel. In their further course through the bi-convex lens xx, the rays are brought to a focus, which is made to coincide, by adjusting this lens on the sliding bar, with the principal focus of the lower lens of the Abbé condenser in the microscope (m). The lower lens of the Abbé condenser renders the rays parallel, while its second lens converges them and brings them to a focus in the plane of the object, giving there a small, but very bright image of the source of illumination.

The second method consists in the use of a plano-convex lens of much shorter focus than the above. It is mounted in a metal frame, which is fastened to the wall, and by means of set screws permits of perpendicular and lateral movement. The collar is also movable in the optical axis, so that adjustment for accurately focusing the lamp is accomplished by means of the set screw, which is moved back and forth until a bright beam of light, not greater in diameter than the lens itself, is projected on the screen.

The light filter used is the bichromate of potash and sulphate of copper solution, as recommended by Neuhaus. It is made as follows:

Sulphate of copper, ...	175 grams.
Bichromate of potash, ...	17 grams.
Sulphuric acid, ...	2 cc.
Water, ...	from 500–1000 cc.

More concentrated solution is applicable to specimens stained very slightly with the various blues (hæmatoxylon and anilin, etc.) or with the reds, particularly safranin preparations. The position of the light filter is of little moment, provided that the rays of light which pass through it are the only ones which reach the Abbé condenser.

The plates used with greatest success are those made by the "Cramer Dry Plate Company" of St. Louis, Mo. They are orthochromatic in the widest sense, are very uniform, and the instantaneous and extra rapid plates made by this company are sensitive to an exquisite degree. The development of the plates is accomplished as advised by and after the formula of the manufacturers, by a combination of hydroquinone and eikonogen. C. W. J

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L. B. ELLIOTT, EDITOR.

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ALTHOUGH the recent development of laboratory methods has brought about gratifying results, it has not been free from perplexing problems that usually accompany movements of similar nature. One of these problems is the management of the laboratory, *i. e.*, the method of developing and maintaining a working laboratory. At present the difficulty is most obvious in the secondary schools, where the laboratory has but recently been introduced. Our college laboratories are under the supervision of men who have charge of the department for a series of years, and are thus able to carry out a definite policy. On the contrary the high-school laboratory is controlled by a constantly changing management, by men of varying tastes and often very dissimilar ideas. If the high-school laboratory is to develop to its greatest degree of usefulness, it must be placed in the hands of men who understand its needs and are able to carry out their plans in meeting those needs.

There must be a systematic growth. In few cases is it possible to equip a laboratory and place it on a working basis all at one time, for it demands a considerable outlay, and in most instances this will not be available until the people who support the schools are taught that a laboratory is a practical thing—a good investment—and are convinced that they must have it.

Under present conditions, therefore, the well equipped laboratory must be obtained by slow but constant progress, just as any other enterprise struggles to success.

A laboratory is not a laboratory unless equipped with apparatus of such character and in such amount that the work of the department can be successfully carried out. It is, therefore, an important question what apparatus shall be secured, where only limited funds are allowed for that purpose. The purchasing of the equipment recommended by the teacher should be placed in the hands of men of business experience. If, however, the teacher is to make the purchases, there should be some way provided by which he may acquaint himself with the best and most economical methods of securing the equipment needed. For this instruction we must look to the college where, either as part of courses already established, or in special courses to be arranged, those who prepare themselves for teaching science may be taught what apparatus to purchase, how best to secure it, how to use it, and how to take care of it. After apparatus is secured it should be cared for. It is no rare occurrence to find laboratories, so called, where apparatus, when not in use, is piled away under tables, on top of book cases, in the basement, any place to get it out of the way. With such treatment it cannot be expected that apparatus will be accurate or durable, neither can the people be expected to support such a policy. It would be better not to purchase it at all, until means are provided for its preservation.

The equipment of a laboratory requires constant attention. The teacher who has been properly instructed in the construction and use of apparatus, will be able with a little care and attention each day to keep his laboratory in good working order, thus not only getting the most good out of what he has, but retaining the support of those upon whom he must depend for the further needs of his laboratory.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to Charles J. Chamberlain, University of Chicago, Chicago, Ill.

REVIEWS.

Clark, J. F. On the toxic effect of deleterious agents on the germination and development of certain filamentous fungi. Bot. Gaz. **28**: 289–327, 378–404, 1899.

In this paper are presented the results of experiments recently performed at Cornell University. A very great amount of careful work has been done to determine the critical points (i. e., the concentration which kills, and that which inhibits germination) of concentration regarding a rather large number of substances as related to five species of fungi. The data obtained are of such a nature that they do not admit of condensation or abstraction, and only a few of the more general conclusions may be mentioned here, viz.:

"Many deleterious agents which at certain concentrations retard germination and early growth, afterwards cause a great acceleration of mycelial development."

"One is not justified in drawing any conclusions as to the killing powers of an agent from its effect in inhibiting the germination of the spores."

The following conclusions confirm earlier work:

"Fungi are in general much more resistant to most deleterious agents than the higher plants."

"Different species of fungi present great differences of resistance to many agents."

"Individual spores taken from the same pure culture often present considerable variation in resistance."

"The effect of different deleterious agents on the appearance of the mycelium is very varied, and often quite characteristic."

It should be mentioned that the various chemicals employed were in solution in a "*beet infusion*," and that the results are, therefore, not comparable with other results unless attained by identical methods. It is very evident that a highly unstable organic infusion will chemically alter many of the salts employed, and will also materially change the physical, particularly the osmotic, relations. The conditions described are therefore particular and not general.

Chicago. F. L. STEVENS.

Campbell, D. H. Die Entwickelung des Embryosackes von Peperomia pellucida Kunth. Ber. d. deutsch. bot. Gesell. **17**: 452–456, Pl. 31, 1899.

The February issue of the JOURNAL referred to Prof. Campbell's short paper in the Annals of Botany. A more extended account, accompanied by a plate, now gives a fuller account. In all the species investigated, there are sixteen free nuclei in the sac before fertilization. These nuclei are exactly alike, and are not collected at opposite ends of the sac. One of the nuclei becomes larger before fertilization, and is to be regarded as the egg nucleus; there are no

sharply defined synergids and no genuine antipodals, although a variable number of nuclei show a tendency to group themselves at the chalazal end of the sac. No polar nuclei or fusions of nuclei were observed.

In one case the male nucleus, which is small and somewhat spirally coiled, was observed within the egg.

The first division of the embryo, which has no suspensor, is vertical, and the second transverse. In the ripe seed the embryo fills the entire sac, but no organs are yet differentiated. The free nuclei of the embryo-sac do not divide at all, their function being performed by the perisperm.

The writer regards *Peperomia* as a transition form between the angiosperms and lower seed plants, or perhaps the higher pteridophytes. It is a very old type and should, apparently, be placed at the beginning of the angiosperms.

C. J. C.

Nawaschin, S. Embryology of Corylus. Bull. Acad. Imp. Sci. St. Petersburg, **10**: 375–91, Pls. 2, 1899.

In his previous study of this genus Prof. Nawaschin had already discovered the chalazal entrance of the pollen tube, and had made some notes on the embryology. The present paper is largely devoted to the earlier stages of oögenesis. There are often as many as twelve sporogenous cells which, by further division, may give rise to twenty or more macrospores, but sometimes only a single macrospore is produced and in any case only a single macrospore reaches maturity. At the time of fertilization there is no typical egg apparatus, but only a mass of protoplasm with free nuclei. The antipodals have cellulose membranes. The further development presents nothing new.

C. J. C.

Fairman, C. E. Puff Balls, Slime Moulds, and Cup Fungi of Orleans Co., N. Y. Proc. Rochester Acad. Sci., **3**: 206–220, 1900.

This is a list of species. Each species is accompanied by notes on habitat, etc., and also by references to the literature of the subject. Since many of the forms have a very wide distribution in the United States, these references will be found quite convenient. Saccardo's "Sylloge Fungorum" has been followed in arranging the Gasteromycetæ and Discomycetæ, while the Myxomycetæ follow the order observed in Prof. Macbride's recent work on the "North American Slime Moulds."

C. J. C.

Tieghem, Ph. v. Sur l'organisation florale des Balanophoracees. Bull. Soc. Bot. de France, Mai-Juin, 1896.

Treub, Dr. Melchoir, L'organe femelle et l'apogamie du Balanophora elongata, Bl., Ann. Jard. Buitenz., **15**: 1–22, Pl. 1–8, 1898.

Lotsy, Dr. J. P. Balanophora globosa Jungh., Ann. Jard. Buitenz. 2nd Ser., **1**: 174–186, Pl. 26–29, 1899.

Hofmeister's description of the female organ of the Balanophoraceæ carries on its face such a suggestion of inaccuracy as to require a closer study of the form. He finds ovule, funiculus, micropyle and fertilization as elsewhere. Van Tieghem declares there is no ovule or placenta in *B. indica;* that there is a megaspore plunged into the tissue at the base of the style, that the polar nuclei do not fuse, and that fertilization occurs indifferently in the antipodal or sexual end of the sack. Treub has published a very close series of figures from the earliest stages to mature fruit, using the form *B. elongata*, which is abundant near him. He finds

that there is no ovule or placenta, that there is an epidermal growth called the style without a micropyle, that the polar nuclei do not fuse, that fertilization does not take place and that the endosperm invariably develops from the upper polar nucleus. Periclinal walls cut off a cell within this endosperm and this centrally located cell develops an amorphous embryo; embryo, endosperm and the base of the "style," transformed into a seed coat, form the mature fruit. Treub found no signs of fertilization, though dealing with a species which had staminate inflorescences. Dr. Lotsy, however, confirms Treub in every particular, including non-fertilization, from evidence furnished by abundant specimens of *B. globosa*, which has no staminate flowers. He objects in toto to the term "style" in describing this peculiar female organ. Both Treub and Lotsy look forward for phylogenetic hints to the study of *Rhopalocnemis phalloides* Jungh. Dr. Lotsy is very anxious that *B. indica* be worked over again with care. Perhaps this would be a fertile field for careful cytological investigation.

Chicago. JNO. E. WEBB.

Brand F. von. Cladophora-Studien. Bot. Centralbl. **79**: 145–52, 177–86, 209–21, 287–311, Pl. 1–3, 1899.

This rather long paper brings together an immense amount of detail, in regard to European Cladophoras. The principal conclusions are: That there is much more variation in what have been regarded as specific characters than has been supposed, all the species of European Cladophoras as described by Rabenhorst being regarded as mere varieties of *C. fracta* or *C. glomerata;* the relative length of cells is so variable that it should not be used by itself as a specific character; species with strong basal attachment usually form zoöspores, while free forms more commonly produce resting spores. C. J. C.

Nathanson, A. Ueber Parthenogenesis bei Marsilea und ihre Abhängigkeit von der Temperatur. Ber. d. deutsch. bot. Gesell. **18**: 99–110, 1900.

A widening knowledge of reproduction in the lower forms has shown that the line between sexual and asexual reproduction is not so sharp as was formerly imagined, and suggests that even in higher plants, where parthenogenesis does not normally occur, it might possibly be induced by artificial means. The only clearly proven case of parthenogenesis in Spermatophytes is furnished by Juel in his account of *Antennaria alpina.* Shaw's experiments led him to believe that in *Marsilea Drummondii*, parthenogenesis may occur under normal conditions.

The present writer confirms Shaw's work and finds that in *M. Drummondii* about 90 per cent. of the macrospores produce parthenogenetic embryos. *M. vestita* was then tried, but the isolated macrospores under otherwise normal conditions produced no embryos. Numerous attempts to induce parthenogenesis by using chemicals were unsuccessful, but by raising the temperature parthenogenetic embryos were obtained. In a lot of 750 isolated macrospores, at the temperature of the room, only one embryo was found, but in a lot of 466 spores at a temperature of 35° C. 34 parthenogenetic embryos were developed. These embryos when placed in moist soil continued to develop exactly like embryos resulting from fertilized egg cells. In *M. acra* 101 isolated macrospores at the temperature of the room failed to produce a single embryo, but out

of 67 macrospores, at a temperature of 35° C., eight developed parthenogenetic embryos.

The writer satisfied himself that the embryos were truly parthenogenetic and not merely adventitious.

C. J. C.

CYTOLOGY, EMBRYOLOGY, AND MICROSCOPICAL METHODS.

AGNES M. CLAYPOLE.

Separates of papers and books on animal biology should be sent for review to
Agnes M. Claypole, Sage College,
Ithaca, N. Y.

CURRENT LITERATURE.

Loeb, J. On the Different Effects of Ions upon Myogenie and Neurogenie Ryhthmical Contractions, and upon Embryonic and Muscular Tissue. Am. Jour. of Physiol. 3: No. 8, 382-396, 1900.

In this paper the author starts on the ground established in the preceding paper, that irritability depends on the various ions, especially the metallic ions (Na, Ca, K, and Mg), existing in definite proportions in the tissues. Gonionemus was used for further experiments to demonstrate the relations between contractions of the centre and margin, and their dependence on or independence of nerve stimuli. The swimming bell of this Medusa contracts rapidly for a short time and then ceases, and the contractions are repeated. The marginal portions contain the nerve ring and ganglia, and the central only having scattered nerve cells. A typical difference is found between the effects of ions on rhythmical contractions originating in muscles directly, and in parts containing ganglia. Since the whole Gonionemus beats in the rhythm of the margin, and also is as immune to the Ca and K-ions of sea water as the margin, it follows that the normal contractions of the Gonionemus originate in the part containing ganglia. It is also probable that the margin and center contain the three ions Na, K and Ca in different proportions. From further work it is evident that the rhythmical contractions depend on the presence of these three ions in definite proportions in the ion-proteids of the tissues. These proportions clearly differ in various kinds of tissue. Myogenic contractions are prevented by smaller amounts of K and Ca-ions in the surrounding Na Cl solution than neurogenic contractions or contractions originating in parts containing ganglia. In his general conclusions the author takes up the wider bearing of the question. There has been a controversy as to whether the contractions of the heart are myogenic or neurogenic, and the same question applies to Gonionemus, where under ordinary circumstances the contractions are neurogenic. It is the chemical nature of the nerve tissue that is of greatest importance. It is not said that calcium or other ions are the cause of or stimulus for rhythmical contractions, but that the three metallic ions must be present in certain proportions that must be preserved to keep the physiological activity intact; such contraction can be stopped, started,

or its rate increased by change of these proportions. On the question of the resemblance between the phenomena of cell division and muscular activity the author speaks with definiteness. Since the presence of enormous quantities of K-ions has no effect on the processes of karyokinesis, the evidence is decidedly against any close similarity. It is clear that these three metallic ions are needed in different proportions for the best activity of different tissues, and it is probable that their main importance lies in their influence on the physical qualities of protoplasm (absorption of liquids, states of matter, etc.). In a later paper the author shows that embryonic development takes place in mixtures of $Mg\,Cl_2$ and $Ca\,Cl_2$, but each serves for only partial development. A solution of Na Cl, with a small amount of Ca and K-ions, is necessary for the whole cycle of life phenomena. It appears that certain salts are only necessary when others are present, as if for antidotes or balancing purposes. A. M. C.

NORMAL AND PATHOLOGICAL HISTOLOGY.

RICHARD M. PEARCE, M. D.

Harvard Medical School, Boston, Mass., to whom all books and papers on these subjects should be sent for review.

Heinz. On the Source of the Fibrin and the Origin of the Adhesions in Acute Adhesive Inflammation of Serous Surfaces. Virchow's Archiv. CLX, 365, 1900.

Heinz discusses the two views held at present in regard to the source of the fibrin on serous surfaces in acute inflammation, and presents in support of one of them (that of Marchand and Ziegler) the results of the study of experimental lesions produced in rabbits.

That the fibrinous layer results from a swelling and fibrinoid degeneration of the upper layers of the serosa is the theory supported by Neumann and Grawitz; while according to Marchand and Ziegler it is due to the fibrinous coagulation of plasma exuding from the superficial blood vessels.

Heinz used as an irritant a solution of iodine in iodide of sodium. This was injected into the pleural and peritoneal cavities with the following results:

I. In the pleural cavity a definite layer of fibrin, due to coagulation of the plasma which exudes from the vessels, is formed on the surface of the serosa, from which, however, it is very sharply marked off.

II. The pleural epithelium, when not destroyed by the iodine, is left intact beneath the layer of fibrin, and is in direct contact with the serosa; in a few cases small patches of the epithelium are lifted by the exudate and lie on top of the fibrin.

III. The exudate in passing from the vessels in the lung to the pleural cavity may coagulate, and impregnate the tissues, thus giving rise to an apparent fibrinoid degeneration of the connective tissue.

IV. Superficial loss of substance, due to the action of the iodine with consequent repair, explains the occasional presence of bits of connective and elastic tissue in the exudate.

In similar injections into the peritoneal cavity it was found that the resulting fibrinous exudate was most abundant along the lines of contact of the coils

of intestine. Beneath the fibrin the serosa tissue presents a peculiar hyaline appearance which is considered by some investigators to be due to a fibrinoid degeneration, but by Ziegler and the writer to be due to a hyaline degeneration. The coils of intestine are held together at first by the fibrin. Later the formation of connective tissue produces definite adhesions. The serosa-epithelium (endothelium) while intact protects serous surfaces from adhesions. The latter form only where the endothelium has been destroyed.

Virchow. Psammona Virchow's Archiv. CLX, S. 32, 1900. Virchow calls attention to the confusion that has arisen in the use of the term psammona since his introduction of the word in 1863. His classification of the diseases of the brain associated with "Sand-formation," he believes is still sufficiently clear to prevent misunderstanding. Quoting from his original description, he says: "Only those tumors in which the sand-like masses are analogous to those occurring normally in the brains of adults, are included. Among these one may distinguish two classes. The sand is either in the interior of connective tissue bundles, or it lies more loosely in and between the parts, so that the individual granules may be isolated easily."

He distinctly excluded the calcified endotheliomata and other processes associated with calcification, to which the term has been so frequently applied.

Yamagiwa. A New Stain for Neuroglia Fibres. Virchow's Archiv. CLX, 358, 1900. Yamagiwa gives the following method based on Stroebe's stain for axis cylinders:

1. Harden very thin pieces of fresh tissue in Muller's fluid for about one month, changing the solution daily during the first week.
2. Transfer directly to absolute alcohol for several days to a week.
3. Imbed in celloidin.
4. Stain the sections in a saturated alcoholic solution of eosin for twelve hours or longer.
5. Transfer to a concentrated aqueous solution of aniline blue for four to six hours.
6. Differentiate in dilute alcohol made slightly alkaline by the addition of a few drops of a one per cent. solution of caustic potash. (The deep blue sections become at once or gradually reddish brown according to the alkalinity of the alcohol).
7. Wash out the alkaline alcohol in water.
8. Remove the excess of aniline blue in dilute alcohol. (The sections show a reddish color.)
9. Dehydrate in absolute alcohol.
10. Clear in oleum origani cretici.
11. Xylol balsam.

The axis cylinders stain deep blue, the neuroglia fibres and the red blood globules dark red, myelin sheaths light red, the protoplasm of neuroglia cells pale violet or bluish red, the cell body of the ganglion cells pale bluish gray, connective tissue fibres, adventitia, and the intima of blood vessels sky blue to pale green, the nuclear membrane of all cells blue, the nucleoli deep violet to deep blue.

The method succeeds only with fresh tissue cut into very thin slices and properly hardened. Tissue left in alcohol too long refuses to hold the eosin stain.

Yamagiwa concludes from the study of his sections that the neuroglia cells in the developed nervous system offer points of support for the neuroglia fibres which are nothing else than the differentiated, peripheral parts of the neuroglia cells whose cell body is not sharply circumscribed by a special membrane. In other words, the neuroglia fibres represent a differentiated intercellular substance which, however, is not entirely or not everywhere separated from the cells.

Janni. The Finer Changes in the Walls of Varicose Veins. Archiv. fur klinische Chirurgie, LXI, 12, 1900.

Janni observed not only degenerative changes brought about by the distention of the veins but also a new formation of connective tissue, which was sometimes quite marked. This new growth of connective tissue occurred chiefly in the intima giving rise to an endo-phlebitis characterized by the formation of nodules or flat areas of thickening.

In these endo-phlebitic growths there was a breaking down of the internal limiting membrane into thinner elastic sheets and fibres. This destruction of the inner elastic limiting membrane is easily demonstrable, and is associated, particularly in the large nodules, with a new formation of elastic tissue which is sometimes abundant.

In the inner portion of the media there was often a new formation of connective tissue limited to those places where the nodules or plates had formed.

Janni asserts that the endo-phlebitis is the primary change in the vessel wall. He does not regard it as compensatory in character as Epstein maintains.

NEUROLOGICAL LITERATURE.

Literature for Review should be sent to JOURNAL OF APPLIED MICROSCOPY, Rochester, N. Y.

Müller, Erik. Studien ueber Neuroglia. Archi. f. Mikr. Anat. **55**: 62, Tf. 2–4, 1899.

This presents a study of the evolution and differentiation of the neuroglia based upon observations upon amphioxus, cyclostomes selachia, teleosts, amphibia, reptiles, and mammals.

In the last three the results were not as satisfactory as in the other forms studied. He holds that the neuroglia is a tissue, ectodermal in origin, forming the skeleton of the nervous system, and transitional between pure epithelial and connective tissue. The glia fibers are cell processes, morphologically as well as physico-chemically, differentiation products of the glia cells.

As might naturally be expected, he found the most primitive arrangement in amphioxus, where the whole supporting tissue is developed from ependyma cells. These are small, cone shaped elements, forming a single layer around the cleft-like central canal and sending out fibers from their distal end, part of which, the "bundle fibers," are comparatively heavy and form bundles that extend through the spinal cord to the periphery, while the others, the "geflechtsfasern," form a fine network which surrounds the nervous elements and penetrates both the gray and white substance.

The "bundle fibers" extend out from the central canal with a *quasi* regularity in certain vertical levels, and form a definite number of ependyma septa. The orderly arrangement of these septa is important, and they are constantly present in the lower vertebrates. The other fibers are numerous, take horizontal, longitudinal or oblique courses, surrounding the cells and running between the nerves. Both forms end undivided at the periphery of the cord in foot-like thickenings. Both Hansen and Rohde found supporting fibers running from the spinal cord into the dorsal nerve stem. Mueller demonstrated, at the root of the nerve, a group of very small, branched cells sending processes into both the cord and the nerve stem, which he thinks are true glia-cells. The most important characteristic of the neuroglia in the cord of amphioxus is not the radially running processes of ependyma cells, but the origin of the bulk of the supporting tissue in cells surrounding the central canal. Their processes play a double rôle, being comparable on one hand with the ependyma cells of higher vertebrates, and on the other with the glia cells, since they are intimately associated with the neural elements of both white and gray matter. Myxine representing the cyclostomes shows an enormous number of fibers in the cord. The ependyma cells have a somewhat bilateral arrangement, and their processes do not penetrate the cord in all directions, but unite in bundles extending in definite directions and disposed in uniform vertical levels. There are horizontal, longitudinal and oblique tracts as before, the horizontal tracts being most important. There are also nerve cells and large glia cells, the glia cells in the white matter being collected into groups; there is a striking correspondence between the arrangement of the glia elements and the neural elements.

Of the Selachia, embryos of *Acanthias vulgaris* measuring 3, 5, and 25 cm. were studied. The ependyma cells here lack the processes so characteristic for amphioxus and myxine. The gray matter shows a thick network of glia fibers running in different directions and extending through the white matter to the periphery. Most of the fibers are horizontal, but some are oblique and longitudinal as before.

The ependyma cells of the teleosts correspond structurally with those of amphioxus and myxine. They are cylindrical and form a single layer around the central canal, and their fibers form bundles running in definite tracts. Other supporting elements are the pear-shaped astroblasts lying in the gray substance and sending out processes in all directions. The glia is more prominent in the dorsal than in the ventral horn, and is composed of coarse and fine fibers. There are also large tracts of glia elements symmetrically disposed at the sides of the central canal.

Among the Amphibia, Reptilia, and Mammalia he found the glia elements essentially the same as in the lower forms. This tissue was characterized in all the forms by unstained cells, and stained fibers ending in a cone. He found nothing to support Cajal's theory of the contractility of glia cells.

Method: Specimens of amphioxus and myxine fixed for twenty-four hours in a mixture of one part 3 per cent. calcium bichromate and four parts commercial formol, followed by three days in 3 per cent. calcium bichromate; wash one hour in running water and place in 70 per cent. alcohol. Stain by the Heiden-

hain iron hæmatoxylin method, being specially careful to wash thoroughly. For the shark and bony fishes, he recommends a mixture of glacial acetic acid and absolute alcohol or Carnoy's fluid. E. M. B.

Gruenstein, N. Zur Innervation der Harublase. Arch. f. Mikr. Anat. **55**: 1–11, Tf. 1, 1899. Macroscopic examination of the frog shows that the bladder is innervated by cerebro-spinal as well as sympathetic nerves. Both systems of nerves form a thin nerve stem which leaves directly under the place of union of the eighth and ninth nerves in the lumbar plexus. In addition to these the wall of the bladder has a large number of automatic neural structures in the form of large nerve knots which are resolved under the microscope into ganglionic masses of brownish yellow, pigmented, round or oval cells, with one or two processes. Outside of the ganglia there are many isolated cells in the wall of the bladder which are surrounded by a distinct pericellular network. Many of the processes give off lateral branches ending in a pericellular network, i. e., a fiber may send impulses to several cells—the same relation shown by Smirnon to exist in other ganglia of the frog.

Within the wall of the bladder these pericellular fibrils never have a medullated sheath, and probably represent the unmedullated fibers of Remak. The myellated fibers belong to two categories,—thin fibers few in number of the sympathetic system, and thick fibers of the cerebro-spinal system, sensory in nature and with a characteristic termination. The fiber branches repeatedly, becoming thinner and losing its myellated sheath, until it falls into a mass of thin varicose fibrils, each of which terminates in a button-like thickening, the whole forming a terminal "tree."

The mouse, rat, cat, and dog were also studied. Here the neural elements accompany the blood vessels. The cells are large and multipolar. Only intermuscular end apparatus, apparently sub-epithelial, was found.

The terminal branchings of the fibrils are less complicated than in the frog. Erlich's methylen blue method was used for staining.

Trebosch, Dr. med. With. Vergleichend-anatomische Untersuchungen ueber den Ursprung und die Phylogenese des N. accessorius Willisii. Arch. f. Mikr. Anat. **54**: 514–602, pl. 27, 1899. The writer made a careful investigation of the accessory nerve in Amphibia, Sauropsida, and Mammalia, with special reference to its relation to the brain and spinal cord, its position with regard to the anterior and posterior nerve roots, and its significance in the series of cerebro-spinal nerves. The appended chronological index with its 111 titles, one dated 1664, the historical interest of the subject apparent, while the author's statement that our ideas on the subject are not much clearer than those of the anatomists 200 years ago, gives some idea of the difficulties involved in the investigations.

All agree that in the amphibia the accessorius, glossopharyngeal, and vagus do not exist independently, but form a plexus in which the portion corresponding to the accessory never reaches back to the region of the spinal nerves. The importance of the vagus group in this class lies in the imperfect separation of distal motor elements, and in the fact that all motor components of the group pass out below the trigeminous root.

In the Sauropsida the course of the nerve is almost horizontal instead of oblique, and it is on the dorsal instead of the lateral side of the cord as in mammals. The most striking difference between reptiles and amphibia lies in the number of accessory roots with their characteristic segmental arrangement, as far as they penetrate the spinal cord.

The turtle has a mixed vagus-accessory nerve with its distal fibers exclusively motor. In birds and reptiles it always arises in segmentally arranged parts of the spinal cord, each curvical nerve pair corresponding to an accessory root, and with from four to six additional roots in the medulla oblongata. The structure is simplest and clearest in the turtle. Here, better than in the birds studied, may be seen how the distal, purely motor portion runs along with the segmental spinal portions. The accessory of the chick is purely motor only in the distal portion. Beyond a certain point there is no more an independent accessorius than an independent vagus, but the nerve roots are mingled in the centrifugal and centripetal tracts of the spinal cord.

Comparing the classes studied, the vagus group of the Amphibia does not penetrate into the spinal cord. Next above this there is a fundamental amniote form characterized by intimate connection with the vagus, by extending into at least the first cervical segment, and by its origin from a lateral aggregation of cells in the anterior horn with subsequent course along the neural side of the posterior horn of the spinal cord. From this fundamental form the reptiles and birds have developed in one series, and the mammals in another, so that while the more highly differentiated forms show important differences, there are similarities among the lower members.

In the Sauropsida the accessorius has characteristics which in mammals are peculiar to the vagus alone, and in Sauropsida the parts belonging to the spinal cord have the same characteristics as those of the medulla. In the mammals the positions belonging to the spinal cord have undergone noticeable changes.

Brain Material for Macroscopic Study.—The brain is hardened in potassium bichromate, thoroughly washed in water and placed in alcohol. The bichromate stains the nerve fibers with an intensity that varies according to their thickness, making the conducting tracts more easily traceable.

As the brain is liable to sink to the bottom of the fluid and become flattened on the side upon which it rests, it is a good plan to suspend it in a piece of cheese-cloth, which may be tied to a stick laid across the top of the jar, and this arrangement will also allow the fluid to penetrate equally on all sides.

Schwalbe's Method for Preparing Dry Specimens of Brains.—Harden the brain in zinc chloride, then wash carefully and dehydrate in 96 or 97 per cent. alcohol and leave in turpentine for eight days.

After this place the brain in a bath of paraffin melting at from 45° to 50° C, for from five to eight days, until it is thoroughly penetrated, then drain off the paraffin and cool the specimen, being careful to place it in such a position that it will not become distorted while hardening.

NOTES ON RECENT MINERALOGICAL LITERATURE.

ALFRED J. MOSES AND LEA McI. LUQUER.

Books and reprints for review should be sent to Alfred J. Moses, Columbia University, New York, N. Y.

E. von Fedorow. Weiss'sches Zonengesetz und neue Krystallographie (ohne Rechnung). Zeit. f. Kryst u. Min. **32**: 131, 1899.

Prof. von Fedorow devotes some twenty pages to a preliminary paper upon the new or zonal crystallography, in which the present methods of calculation are, he believes, to be replaced by equally accurate graphic methods. The result is to be obtained by the use of very accurately ruled "stereographic nets" and a special universal goniometer with three axes and two very small mirrors which can take any desired orientation. No details of construction are given, but it is stated that no adjustment of the crystal is necessary, and all usual problems of crystallography, determination of geometric constants, symbols, and interfacial angles will be solved graphically without calculation.

The underlying principle is the zone law of Weiss, that if the position in space of any four faces is given (no three being in the same zone) the position of any other face may be determined. A. J. M.

F. Wallerant. Méthode de détermination rapide des feldspaths des roches. Bull. Soc. Min. **21**: 268, 1898.

The usual methods for determination require the existence of special conditions in the feldspar crystals, such as twinning, cleavage planes, sections of known orientation, etc. The author indicates a rapid method, consisting in the determination of the mean index of refraction by total reflection, and not requiring any special conditions in the given section.

As the axial angle is about 90° and the double refraction very weak, the mean index β can be regarded as practically the average of the indices of the faster and slower rays, passing through the section in the same direction.

In Vol. 20 of the bulletin the author describes an accessory piece of apparatus to the microscope for obtaining indices of refraction, by the principle of total reflection, of the two rays following the same path, however inclined to the surface of the section.

Much more rapid work can be accomplished, however, by making only one measurement which gives directly a mean value.

When the microscope described is properly arranged for the test, part of the field is dark, and separated from the white portion by a green band. The line of separation between the green and white evidently corresponds with the line of extinction of the yellow rays; and by measuring the angle α of the normal to the face of the prism with the rays passing this line of separation, an angle is obtained differing at most 10′ from the angle corresponding to the mean index of the crystal.

The indices are then obtained from a table, in which the angles α have been calculated for the mean indices β.

Only three or four minutes are required for a determination, and examples are given of the application of this method.

L. McI. L.

INDIVIDUAL SPECIES.

Atacamite, from Sierra Gorda, Chili. G. F. Herbert Smith. Min. Mag. **12:** 15, 1898.

Axial ratio calculated from exceptionally good specimens is $a:b:c=0.66130:1:0.75293$. Crystals prismatic in habit, with pyramids (111) and (121) prominent, (011) small, and (132) new.

Holohedral character indicated by etched figures and absence of electric polarity.

For green light $\alpha = 1.861$, $\beta = 1.831$ and $\gamma = 1.380$ (determined for first time). Axial plane parallel (100). Acute bisectrix normal (010). $2E = 95°–97°$ (Th. light). $2V = 74° 56'$.

Caracolite often associated with the atacamite.

L. McI. L.

Fergusonite, an endothermic mineral. W. Ramsay and M. W. Travers. Proc. Roy. Soc. **62:** 325, 1898.

When heated to a temperature of 500° to 600° it suddenly becomes incandescent, evolves much of its helium (which appears to be in chemical combination), and decreases in density. The mineral also loses heat in parting with the helium.

The authors think it probable that the minerals containing the rare elements represent a portion of the interior of the earth where, under conditions there obtaining, combination with helium was exothermic; but that these compounds under surface conditions (less pressure, etc.) become endothermic.

L. McI. L.

F. Zambonini. Ueber zwei neue Hydrosilicate. Zeit. f. Kryst. u. Min., **32:** 157, 1899.

MÜLLERITE.—A specimen from Nontron, Dordogne, France, was coated with a dull yellowish green crust with yellow streak. It was apparently homogeneous under the lens, showed no trace of crystals or cleavage, but was compact, opaque, and soft; G.=1.97.

Before blowpipe, infusible, loses water and changes color first to clay yellow, then browner, finally chestnut brown. Partially decomposed in HCl, giving a brownish red solution.

The analysis differed from that of Nontronite principally in the lower water contents, but agreed in this with a mineral from Tirschenreuth in Bavaria, described by Müller. The name Müllerite is therefore given and the formula written $F_2O_3 . 3\ SiO_2 + 2\ H_2O$.

MELITE.—A specimen in the museum of the technical institute at Rome labelled Allophane from Saalfeld, Thuringia, was found to consist of little masses entirely unlike allophane and each composed of a large number of imperfect prismatic crystals, too rough and fragile to be measured or even isolated, and often coated with snow-white, vitreous globules, which are apparently schrötterite.

The color is bluish brown, opaque, very brittle; H=3, G=2.18. Infusible, yielding water. Easily soluble in HCl with separation of silica.

Analysis shows SiO_2, 14.97; Al_2O_3, 35.24; Fe_2O_3, 14.90; CaO, 0.78; H_2O, 33.75 per cent.

Named after Romolo Meli, professor of geology at the University of Rome.

A. J. M.

NEWS AND NOTES.

The ova of frogs and toads are deposited in the water in a transparent gelatinous matrix, and usually attached to plants or dead branches. Both kinds are dark colored, but the frogs' eggs are in ellipsoid masses, and the toads' are placed in a single row in long strings like so many black beads.

A galvanic current passed through the water containing 14-day old tadpoles they all took position with head toward the anode and tail toward the cathode, and were restless if compelled to reverse their position.

METHODS IN FROG EMBRYOLOGY.—It is better to remove the gelatinous envelope from the eggs of Batrachia before treating them with fixing fluids. Hertwig's method is to leave them for five or ten minutes in water at 90° to 96°C., when the envelope may be cut and the ovum removed under water and placed in five per cent. osmic acid or into 70, 80, 90 per cent. alcohol.

GILSON'S MERCURIC-NITRIC MIXTURE.—The albumen may also be removed by leaving them in this fluid for a few days:

Nitric acid (80 per cent.),	78 cc.
Glacial acetic,	22 cc.
Corrosive sublimate,	95-100 g.
Alcohol (60 per cent.),	500 cc.
Distilled water,	4400 cc.

This is a reliable and delicate fixing agent. For marine forms it requires the addition of a few crystals of iodine to prevent the precipitation of sea salts.

PICRO-SULPHURIC ACID.—When it is difficult to remove the inner gelatinous membrane, each egg may be cut out from the matrix with scissors and left for from one to twelve hours in a solution of 35 per cent. alcohol saturated with picric acid and two parts in 100 of sulphuric acid. Wash for several hours in alcohol, increasing from 35 per cent. to 70 per cent. When the egg has been in 70 per cent. about two days, the inner membrane begins to swell and on the third or fourth day may be removed.

FIXATION BY OSMIC ACID AND CHROME-PLATINUM SOLUTION.—Place the ova in one-half per cent. osmic acid for twenty minutes and transfer directly to a solution of equal parts of one per cent. chromic acid and 1.4 per cent. solution of platinic chloride ($Pt\ Cl_4$) for twenty-four hours. Dissect away the gelatinous membrane in water under the dissecting microscope, wash for two hours in flowing water, dehydrate and stain.

EMBEDDING.—Paraffin is preferable for embedding ova and embryos, but the novice often finds difficulty in manipulating it. Ova containing a quantity of yolk may crumble, and embryos are often badly shrunken by the time they are ready to section. A method for preventing the globules from dropping out when sectioned is given on page 464, Vol. II of this journal.

Care should be taken not to allow the paraffin bath to become heated above 50°C. Celloidin is often preferred for embedding because, although it requires a much longer process, it is more dependable for the preservation of delicate tissues.

ORIENTATION.—The simplest method of orientation consists in working the object into position with warm dissecting needles before the embedding mass hardens. If placed with its long axis, or a cleavage furrow in the case of an egg, parallel with the sides of the embedding dish, or in any definite position, the edges of the hardened block will serve as orientation lines when the sections are cut. The object should be moved as little as possible in order to avoid the formation of air bubbles, but if they get into the embedding medium they must be worked out with a warm needle. Eyclesheimer describes a method of embedding in a metal box perforated with a series of opposite holes, through which silk threads are stretched and fastened with a drop of celloidin, leaving a free end about two inches long. The object is oriented according to the stretched threads, the free ends are soaked in a mixture of thin celloidin and lampblack, and the embedding mass hardened. Then the drops of celloidin that hold the threads in position are dissolved in warm water and the blackened ends drawn through the mass, leaving orientation lines.

EXPERIMENTAL METHODS.—There have been many heated discussions concerning the laws governing the cleavage and development of ova, and many experiments have been made, with the result that we have progressed to the point of realizing that the mechanism of vital phenomena is highly complicated, and we really know very little about it at present.

Pflüger compressed frog eggs between two glass plates until they were considerably flattened, and found that the ova divided after forming karyokinetic spindles parallel to the glass. He concludes from this that the dividing cell arranges its elements in whatever direction there is least resistance. The question of the influence of gravity upon cleavage has been much discussed, one of the conclusions drawn being that it has an indirect influence by its action upon the arrangement of the parts of the egg through their specific gravities.

Studies of the developement of sex in the frog showed that more females than males usually develop from a collection of ova. If the tadpoles are fed on meat, or, better, on fish, the percentage of females will be increased. These results agree with those obtained by varying the food of butterfly larvæ, females developing from well nourished larvæ, and males from those not so well fed.

The influence of light on development was tried upon ova of *Rana temporaria* and *R. esculenta* and upon *Salmo trutta* and *Lymnea stagnalis*.

Violet light accelerated development most, and blue next, followed by yellow and white, which have about equal effects. Darkness retards development, and in red and green light the ova did not reach complete development. Sets of tadpoles supplied with a limited amount of food consumed it more quickly and died sooner in violet and blue light than in any other colors. The method of experiment was to plunge the dishes with the ova in colored solutions immediately after fertilization.

The plasticity of animal life finds an example in the tadpole's ability to adapt itself to salt water. They develop in solutions of 2, 4, 6, 8 parts of salt per 1000, but more slowly as the degree of concentration increases. In four per cent. solutions they shrivel and die in from three to twenty minutes, and in one per cent. solutions they die in a few hours unless first left in weaker solutions.

APPARATUS FOR KEEPING CONSTANT TEMPERATURE.—A zinc tank fitted with a cover and a waste pipe is packed around with sawdust and filled with ice. A small opening in the cover is fitted with a cork through which a vertical glass tube passes, carrying a funnel at the top, and water entering here flows over the ice out through the waste pipe into a glass beaker, from which it is conducted through a series of beakers in which the temperature may be gradually raised to any point desired, and the ova may be transferred from one dish to another.

Journal of Applied Microscopy.

VOLUME III. JUNE, 1900. NUMBER 6

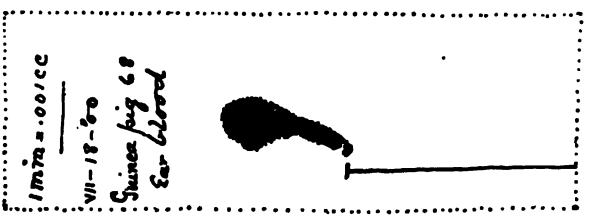
The Application of the Widal-Gruber Reaction with Dried Blood.

The so-called serum reaction, exhibited by the blood of patients suffering from typhoid fever, is one of those laboratory aids in diagnosis which seems destined to come into general use. The reliability of the test, however, is conditional upon an approximately accurate knowledge of the degree of dilution employed. Where the serum which exudes from the blood sample—the fluid method—is used, accurate dilutions are easily obtained and, in fact, have generally been used. This method otherwise presents several serious inconveniences as compared with the dry method—the use of one or more drops of blood dried on paper or slips of glass. The latter, on the other hand, has been found by most workers to be on the whole less reliable in its results.

In certain studies in which I have been recently occupied in the production of immunity against one of the diseases of the lower animals, in many respects analogous to typhoid of man, namely, swine-pest or "hog cholera," a disease in which, in laboratory animals at least, this clumping reaction can be well studied, I have met with the same difficulty. The test with dried blood as usually employed, that is, without any accurate knowledge of the dilution employed, gave less uniform results than with serum.

It is a matter of no little difficulty, an impossibility in fact, to make anything like an accurate guess at the amount of blood represented by a dry stain on paper, the limit of error even after considerable experience being much greater than would be supposed. A dilution, for instance, estimated to be about 1 to 20 may be really three or four times that strength or only one-fourth as strong. This, I have myself found by trial. Estimation of strength of dilution by the depth of color takes no account of the variation in hæmoglobin content, which, as is well known, may be very great. Where no information as to the general condition of the patient, anemic or otherwise, is available this method can give us but little aid. Weighing the dried blood, collecting it on a looped platinum wire, or guessing at the amount in drops when collected, which is perhaps the most common method, are equally open to objections when put in application. Commonly the paper or glass is touched one or more times to the exuding drop and no particular record kept as to the amount.

After some experimenting I have adopted the following method, which satisfactorily meets the two chief requirements, namely, ease of application and approximate accuracy in measurement. Fine glass tubing such as is found in most chemical or microscopical laboratories, or can easily be obtained from the dealers in such supplies, is selected, of such a size that one meter of its length contains about one cubic centimeter of fluid. Its capacity is first ascertained by aspirating water into it to the length of one meter and measuring the quantity thus contained. The capacity of one millimeter is then easily computed. Tubing which contains 1 cc. to the meter (.001 cc. to 1 mm.) within a few centimeters, absolute accuracy not being required, is the best, as the subsequent computation of the dilutions is then more simple. A slightly larger or smaller size, however, may be employed. The tubing is broken into lengths of about 7 cm. and conveniently kept on hand, each piece enclosed in a folded slip of sized paper, destined to receive the blood sample when collected. I make the paper slips when twice folded the size of an ordinary glass slide and keep these containing their pieces of tubing arranged in the usual way in a slide box, each slip being labelled with the capacity of the tube it contains. When the collection is to be made, the piece of tubing held nearly horizontal is touched to the blood as it exudes from a needle puncture in the finger or ear lobe in man, the ear vein of rabbits and guinea pigs, or from an incision in the ear of larger animals. It rises in the tube by capillarity to the desired length, which may be anywhere from one to five centimeters. About 3 cm. makes a suitable sample. The tube is then laid along the paper, the upper end of the column of blood coinciding with the edge of the paper and raised to the vertical position, the escaping blood thus marking on the paper the point to which the measurement should be made. The blood is then expelled on to the paper on either side of this mark by blowing in the end of the tube, a piece of small rubber tubing being interposed if this is thought desirable. The blood should be spread out a little on the paper and expelled before it becomes adherent in the tube, which occurs in a few seconds. I do not attempt to use the small amount of blood adherent to the walls of the tube, but make an allowance for this on making the dilutions, that is, deduct about five per cent. of the length of the blood column. The length of blood column is indicated by a pencil line and the necessary records made as to the date, patient, etc. If the collection is made in the laboratory, the sample is best dried by placing it in or on top of the incubator for half an hour or so. If taken at the bedside, or in the field in the case of animals, they are folded as



before and placed in the slide box at once, the blood of course being outside, and the box carried right side up. If to be sent through the mail, the slip after

drying should be carefully folded so as to enclose the blood sample and prevent the loss of particles which may become detached.

The length of the blood column and the capacity per millimeter of the tube being known, dilutions of any strength desired are easily obtained. As illustration, I insert a copy of a sample slip (folded) now before me, for examination, and which requires no further explanation.

When blood is to be collected outside the laboratory from suspected typhoid patients the physician having the case in hand is supplied on request with the glass tube enclosed in its paper slip, on which the capacity is noted and a printed slip of brief directions, the whole contained in a slide mailing case. For field collections from animals (hog cholera) twelve slips are arranged in an ordinary twenty-five slide box. I have found the samples collected from animals in this way by my (unskilled) laboratory help entirely reliable. Samples collected by physicians from typhoid patients are occasionally rather smaller than desirable, but otherwise satisfactory.

I ought to say in reference to this method of blood collection that it is a modification of one suggested to me by Doctor Stewart of the Massachusetts State Board of Health, where it was proposed to use pieces of tubing weighed before and after blood collection, the blood being left in the tube till used. I have not found this method practicable.

ROBERT R. DINWIDDIE, M. D.
Arkansas Agricultural Experiment Station.

The Laboratory Note Book.

A good note book is essential to good work in the laboratory, and though one finds note books of about all shapes, sizes, and qualities, there are few which are really satisfactory. The note book used at present for general morphology, cytology, etc., at the Botanical Laboratory of the Ohio State University has been

found to be useful and convenient. It is 7 x 10 inches in size. This size is not too large to be easily handled, and is still large enough to hold most of the draw-

ings made by the general student. It is made up of two kinds of paper and two paper covers of stiff cardboard, strengthened with cloth on the back edges; all perforated exactly, with three holes, and tied together loosely with a shoe-string. The paper is unruled and of good quality, so that the notes can be taken in ink; the drawing paper is also such that a good hard pencil or India ink can be used for sketching. A third kind of paper is also kept on hand for the finer work.

This note book will lie absolutely flat on the table and there are no troublesome clamps in the way. It can be folded back to back, can be increased indefinitely in size, and the work can be rearranged in any way desired. The figure gives the general appearance. Such note books can be made by any local dealer at small expense, and the paper sold to the students in any quantity and quality desired.

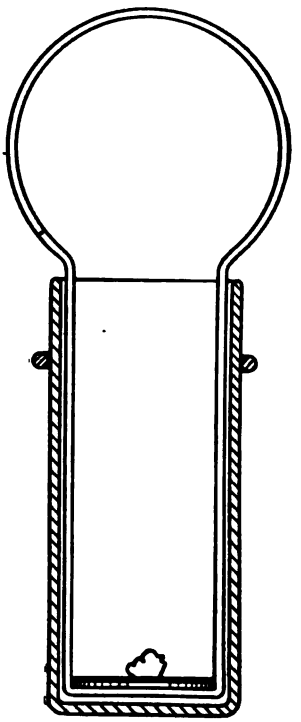
JOHN H. SCHAFFNER.
Botanical Laboratory, Ohio State University.

NOTE.—A very convenient and serviceable microscope cover can be made from heavy manila paper rolled up and glued together in the shape of a slender cone of proper size.

J. H. S.

A Method of Orienting and Imbedding in Paraffin.

Imbedding methods in general use are, no doubt, well adapted to deal with blocks of material of some size, and such as do not require to be oriented with any degree of accuracy, but in the opinion of the writer are not so useful with small objects requiring careful arrangement, in some cases under the dissecting microscope.



SECTION OF TUBE.

The process given below allows of a number of objects being oriented rapidly and fixed in position before infiltration, with the certainty that that position will be maintained throughout.

The material is not touched by any instrument from the time it is placed in position until it is cut out of the paraffin block.

The oriented objects may be stored in the clearing medium until it is desired to embed them.

The paraffin enclosing the material when blocked is free from bubbles and perfectly homogeneous.

The imbedding is done in postal or specimen tubes made from glass tube, without necks.

The object is cemented to the center of a paper disc rather less in diameter than the bore of the tube, and carried when in the bath by a wire holder.

A special celloidin cement is used, consisting of a solution of celloidin chips in equal parts of ether and alcohol, combined with clove oil, about an equal quantity of the latter being required, giving a solution of the consistency of thick honey.

The holders are made of brass wire bent twice at right angles, as shown in figure, to easily fit the

tube, and curved at the upper ends to form handles. A thin sheet brass disc loosely fitting the tube is soldered between the angles. The paper discs may be cut from stout drawing paper with a punch, and should just hold between the upright wires against the brass plate, as it is not desirable to cement them to the latter.

The writer employs an embedding bath having two rows of six holes, fitting the glass tubes which are prevented from dropping entirely through by split rings gripping them. The front row of tubes contains paraffin for the first bath, which may be used over and over again to extract the clearing agent until it becomes too soft.

Proceed as follows: A piece of cleared material is drained on filter paper, placed on a small drop of cement in the center of a paper disc, and oriented. The position being found, a very small quantity of xylol applied at the joint with a pipette fixes the object firmly. It may now be returned to the clearing oil, carrying a number for reference, until a sufficient number are completed, or until it is convenient to embed them.

When it is desired to embed a number of pieces rapidly, twelve tubes are filled with paraffin and placed in the water bath, and six paper discs carrying material have as much of the clearing oil removed as possible with filter paper, and are placed in position in the wire holders and lowered into the first row of tubes, where they remain until infiltrated.

It has been found advantageous to occasionally raise and lower the holders, thus effectually stirring the paraffin and helping the penetration, the discs acting as pistons in the tubes. It is better, also, to keep the discs near the surface of the paraffin while in the first bath.

The changing to the second row of tubes containing fresh paraffin may be effected very readily with the help of the handles, when a second set of six holders with objects may be inserted in the first row.

The writer allows only half the time for the second bath, and therefore while the second set of six objects are being infiltrated in the first row of tubes, there is ample time to withdraw the material and paraffin from the second row and fill the tubes with fresh paraffin ready for the objects now in the first bath.

The holders taken from the six objects imbedded may be used in the first row, with another lot of material, and so on.

The tubes in the second row, *containing* the holders, discs, and specimens, when removed from the bath are immersed for about half their length in ice cold water. As soon as they are perfectly cooled, they are exposed for a moment to the flame of a spirit lamp, turning them well about in the flame. The solid cylinder of paraffin may now be withdrawn from the tube by the handles and allowed to thoroughly set, when it is easily disengaged from the wire holders by springing the side wires apart and pulling it away from the metal disc.

Upon stripping the paper disc from the end, the object is left in position, and a cube containing it may be cut from the end of the rod of paraffin and mounted on a wood block in the usual way for clamping in the object holder, or the cylinder may be of such size as to fit directly into the well if a microtome with a tubular well be employed.

It will be obvious that the paper discs with their numbers may be left adhering to the ends of the rods of paraffin until it is desired to do the cutting, making reference easy.

The paraffin surrounding the objects will be perfectly clear and solid, a bubble being rarely found near the material, therefore the cutting is all that can be desired.

With very small objects, a number may be mounted on one paper disc using a tube of larger diameter. A similar cement has been used by Patten.

Thin cedar oil has been employed for clearing material in this process, and, in conjunction with xylol for hardening the cement holding the object, has given satisfaction. M. T. DENNE.

London, Eng.

Mounting Rhizopod Shells.

In the field of prepared slides for the microscope, no material is more attractive than rhizopod shells. A carefully prepared slide of these dainty little structures, with their varied styles of masonry and widely differing material, is a thing of beauty.

But the best results are only to be obtained at the cost of time and patience. Last winter, during the months least productive of material for the aquatic microscopist, I devoted many evenings to the preparation of slides of these dainty habitations,—having been fortunate enough to begin the winter with a good stock of them on hand. The method employed is as follows:

On the slide to be prepared, make a ring of marine glue, the size of the cover-glass, the thickness depending on the size of the specimens, as the average rhizopod shell is much too fragile to allow any pressure from the cover glass. After this hardens, partially fill the enclosed space with glycerine. Put a drop of the material containing the rhizopods on another slide, without cover-glass, under low power (about half an inch focal distance being required for convenience of working). Find a shell. Then with a bristle (the size and stiffness of which will be determined after a little practice) gently move the shell toward the edge of the drop of water, moving the slide as becomes necessary to keep the operation within the field. Then shove the shell out of the drop onto the slide. A little water will adhere to it. Allow this to *almost* evaporate, meanwhile dipping the end of the bristle in glycerine. When the water surrounding the shell has nearly evaporated, apply the glycerine on the end of the bristle. Then begins the chase. After a little practice one is able, by pushing the shell around on the slide a moment, to cause it to adhere to the end of the bristle. Then hold the bristle, with shell attached, while you remove the slide and place the prepared slide under the microscope. On touching the end of the bristle to the glycerine the shell is readily deposited. Of course if the shell is large enough to be readily seen, it may be laid in the glycerine without the aid of the microscope.

To those not accustomed to working under a compound microscope, the necessity of making every movement in an apparently opposite direction to that desired may at first cause some trouble, but with a little practice this becomes a

habit. I have made many slides and also dissected under the compound microscope without difficulty.

The object of putting a little glycerine on the shell before attempting to pick it up, and before the water has entirely evaporated from it, is this: the opening in the shell is so minute that if it becomes dry (as it would, during the operation of picking it up) the glycerine into which it is afterwards placed cannot get into the interior and displace the air. The result is an air bubble often the full size of the interior of the shell, which makes it appear black and renders it impossible to see distinctly the structure of the shell. When enough shells are on the slide add enough glycerine to fill the ring, lay on the cover glass, and fasten with the cement.

The above method undoubtedly entails a good deal of painstaking labor, but the result is a slide of which one may well be proud, being entirely free from the debris among which the rhizopod is usually found, and containing several species or only one, as desired.

It is an excellent plan to keep on hand a slide prepared with the ring and glycerine, during the collecting season. The glycerine does not evaporate, and all that is necessary is to keep it from the dust. On this slide may be deposited single specimens of rhizopods, the dainty brick edifices of Rotifer melicerta, and other objects of interest as they are met in the summer's work, thus preserving many valuable specimens which might otherwise be lost. When enough have been gathered, they can be covered as a miscellaneous collection, or sorted onto different slides.

The only drawback to glycerine as a mount is that the slides require to be kept right side up when finished and laid away, as the weight of the shells carries them all to the lower edge, if the slide is laid away on edge. This difficulty may be overcome, if desired, by using only a small drop of glycerine in which to collect the specimens, and then filling in around them with melted glycerine jelly.

NELLIE B. PENDERGAST.

A Simple Apparatus for Drawing Objects Natural Size.

The Fig. 1 represents a simple device for reproducing an object diagramatically, natural size.

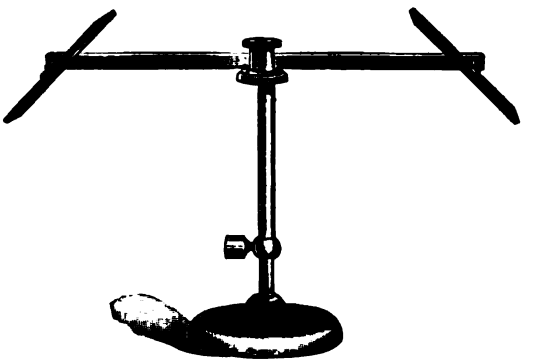


Fig. 1.

The apparatus is constructed as follows: The optical elements—the essential parts of the apparatus—are attached to a horizontal arm supported by a cylinder which sheaths and is freely movable, up and down, upon an upright post, and which may be fixed at any desired position by a lateral thumbscrew. The vertical post is supported by a metal base of sufficient weight to hold the apparatus perfectly stable while in use.

The eyepiece, which consists of a combination of right prisms, to be described below, is attached to the horizontal arm opposite the supporting post. A rectangular mirror is rigidly attached to each end of the bar, and inclined at an angle of 45° to the horizontal.

The diagram (Fig. 2) will aid in making clear the arrangement of parts, and also the optical principle involved.

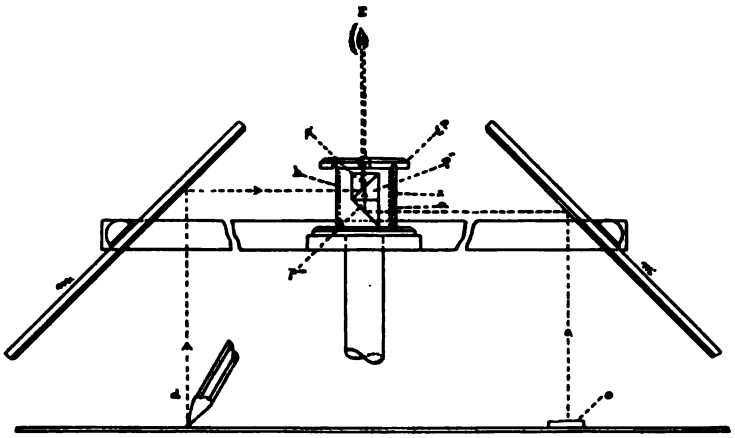


Fig. 2.

The optical parts of the eyepiece (e. p.) consist of a cube formed by cementing two right prisms (p′ and p″) together, the facing surfaces, with the exception of a very small area in the center, being silvered; thus forming a diagonal mirror through the cube, the mirror being pierced at its center by a small hole. It is exactly similar to that of Abbé's camera lucida.

To the lower side of the cube is cemented a third right prism (p‴) with its diagonal surface silvered.

The mirrors (m) and (m′) are of ordinary type and need no special description.

When it is desired to make a drawing of an object, the object is placed on the table directly under one of the mirrors. It makes no difference under which mirror the object is placed, unless it be a matter of convenience in drawing. Suppose the object is placed at (o) under the mirror (m′). The drawing paper is then placed at (d) under the other mirror. Rays of light from the drawing paper at (d) are reflected by the mirror (m) through the aperture (b) in the eyepiece into the prisms, where they strike the diagonal mirror and are again reflected, passing upward into the eye of the observer at (e).

In a very similar manner rays from the object at (o) are reflected into the prism (p‴) through the aperture (a), and are again reflected by the mirrored

surface of the prism, passing upward through the hole in the diagonal mirror, and entering the eye of the observer in such manner that the image of the object is superimposed upon that of the drawing paper.

With pencil or pen it is now an easy matter to trace an accurate outline of the object. The mirrors may be elevated to any height convenient for work, and the drawing produced will be the natural size of the object, as long as the object and drawing paper are in the same horizontal plane. If, however, the object is brought very near to the mirror, and the drawing paper remains upon the table, the drawing will be enlarged to a degree varying as the difference in the distances between the object or drawing paper and their respective mirrors is made to vary. On the other hand, a reduced drawing may be made by placing the drawing paper nearer to its mirror than the object is to its mirror.

When the illumination of the object and drawing paper are unequal, the image from the surface most intensely lighted will appear more distinct than the other. To meet such difficulty a set of modulating glasses are provided, which may be placed over the aperture in the eyepiece on the side that is most intensely lighted, thus equalizing the illumination. H. BAUSCH.

The Action of Water Upon Glass.

An observer in India states that lenses of optical instruments are liable to serious injury from atmospheric influences. Attention was directed to this phenomenon by the observation that domestic glassware, when allowed to stand for some time containing pure water, was more or less dissolved and eaten into. It was afterwards noticed that the glass discs of a Newton's Rings apparatus were attacked and spoiled by the same action. In another case the inner surface of the convex lens in the object combination of a 3½-inch telescope was badly corroded. From the last case it would appear that some kinds of glass are more readily attacked than others, for the flint glass of the other lens of the combination was apparently uninjured. The writer entertains no doubt that the corrosion in the cases cited above was due to moisture which collected between the glass surfaces.

These observations may be of use to optical instrument makers, especially as it appears that only particular kinds of glass are attacked in this way; for it may be possible to avoid glass of that composition; or the edges of combined lenses may be covered with a coating of cement or varnish so as to prevent moisture getting in between them. This action is well known, at least to American instrument makers, who avoid the use of glass that is subject to injury by atmospheric changes.

INK FOR WRITING ON GLASS.—Dissolve 20 g. of brown shellac in 150 cc. of alcohol in the cold, then add, a drop at a time, a solution consisting of 35 g. of borax dissolved in 250 cc. of distilled water. If this precipitates the shellac, add more alcohol, allowing the excess to evaporate afterwards, or warm the solution until the precipitate disappears. One gram of methylen blue will color the ink nicely.—Zeits. fuer Ang. Mikr. Bd. 5, H. F.

Labeling Tissues for Celloidin and Paraffin Infiltration.

The care required in preserving the identity of blocks of tissue during dehydration, infiltration, etc., especially when a number of tissues are carried through at the same time, led me to adopt the following method for attaching a label to each block of tissue so that a number of pieces treated together can be identified when they are ready for embedding.

Write the number corresponding to the number of the stock tissue on one end of an oblong piece of white filter paper, and on the other end place a drop of egg albumen; press the piece of paper at this point to the surface of the tissue opposite that which you wish to section, then place at once in a dehydrating jar. The coagulation of the albumen by the alcohol fixes the label firmly enough so that, with ordinary care in handling, it will remain intact until ready for embedding, and may then be embedded with the block in such a way as to identify it at any future time.

This method is especially useful in pathological work, not only in preserving the identity of the specimen, but in identifying the side of the block from which it may be desired to section. C. M. THURSTON.

Cleveland Homeo. Med. Coll.

Notes on Class Methods.

Some of the following methods may prove useful to teachers:

For rearing Amœbas the following method has been uniformly successful in this laboratory: two or three inches of sand is poured into a common tub, which is then filled with water and placed some feet from a north window. Three or four opened mussels, with merest trace of mud from stream in which they were got, are partially buried in the sand, and a handful of Nitella and a couple of cray-fish, cut in two, are added. As decomposition goes on a very gentle stream of water is allowed to flow into the tub and after from two to four weeks abundant Amœbas are found in surface layer of sand and in the brown growth which appears on the sides of the tub. Small Amœbas usually appear first, and later the larger ones (Amœba proteus and pelomyxa).

In order to get a great abundance of Vorticella and Paramœcium allow hay infusion to stand until a fairly thick zoöglœa is formed, and to this add about twice its volume of pond water, containing some sediment, leaves, and sticks. The smaller Infusoria appear first, later the Vorticella and Paramœcium—the Vorticella attach to bits of the zoöglœa.

Tubifex is a convenient form to keep in the laboratory, both as food for amphibian larvæ and for the demonstration of general body plan of an oligochæte. Tubifex invariably appears in great numbers if mud from the bottom of a stream is deposited upon the sand in such an aquarium as that used for Amœba culture. The worm is very hardy, and lives from year to year in aquaria.

Cray-fish are kept very satisfactorily if treated in a similar manner to frogs. They are placed in a darkened tank, which is kept damp. We have kept them well for six months.

The common terrestrial Isopods as well as the familiar Asellus aquaticus are difficult to dissect, owing to their small size. A useful form is the large species of Ligia, so common about wharves and stone jetties on the Southern coast (Beaufort).

For demonstration of mytotic division, the cray-fish testis is an excellent object in places where it is not convenient to get the lobster.

The small size of the rods and cones makes the mammalian retina a rather unsatisfactory object for an elementary class in histology. For demonstration of rods and cones the eye of Amblystoma larvæ (one inch to one and one-half inches long) is a particularly good object. The whole head may be hardened in Flemming's fluid and serially sectioned.

CLARENCE A. SHORE.
University of North Carolina.

The Use of the Microscope in the Secondary Schools.*

Not long ago I examined a book bearing the title "Evenings at the Microscope." It gave a description of numerous minute objects as seen when highly magnified—hairs, feathers, scales, tongues, and feet of insects, and various other objects of more or less interest. There are schools in which the examination of such objects as these constitutes the work done with the microscope. There is, however, no method in the work, no study of related facts. The microscope is used merely to excite wonder in the child's mind. Such is not the prime function of the microscope in the secondary school.

The acceptance of the cell theory, and the recognition of the evolution of life from small unicellular organisms, simple in structure and function, through a series of organisms of constantly increasing complexity of structure and differentiation of function, have broadened the subject matter of the sciences of life. This subject matter is gradually finding its way into the text-books used in our schools, and teachers are learning that it cannot be fully explained by words alone. They can tell their pupils about the cell and about the complexity of organs composed of numerous cells, but without the aid of the compound microscope they cannot demonstrate objectively the subject of the unit of physical organization, the single cell. The prime function of the microscope, then, in the high school, is to enable the pupil to study the phenomena of unicellular organisms.

I am aware that there are those who insist that the pupil should use his eyes unaided as much as possible; that, when he has learned to observe well with the eyes alone, he should use a common lens, followed by the use of the lower powers of the microscope, and finally by the use of the higher powers. This is undoubtedly true in the study of the structure of some objects, as gross tissues of animals or plants, but for the pupil beginning the study of zoölogy or botany with the idea of examining the fundamental structure of animals or plants, and considering their gradual evolution from lower to higher forms, from simple to more complex organization, this plan does not seem feasible.

* Read before the N. Y. State Science Teachers Association.

As few schools in our State possess more than a single compound microscope, in this paper it will not be supposed that each school is so fully equiped that there is a microscope for every two or three pupils; the attempt will be to portray a possible phase of the use of the microscope preceding its complete introduction into our schools. Bearing this fact in mind, let us consider briefly its use in the study of zoölogy, botany, and physiology, respectively.

In zoölogy the pupil should begin with the study of one of the unicellular forms, the Amœba, the Paramœcium, or the Vorticella. Let the specimen be mounted and the microscope be adjusted by the teacher. The teacher should at first tell the pupil what he is expected to see. This seems necessary inasmuch as the pupil will probably not be skilled in observation, and the time of observation for each pupil will of course be limited. The pupil should make drawings and notes of his observations, which should be submitted to the teacher for criticism. The teacher should let the mount stand and encourage each pupil to study it at odd times, during intermissions and after school hours; endeavoring to discover how it eats, how it assimilates, how it grows, and how it reproduces. The pupil should be taught that this small organism has all the essential properties of life; contractility, irritability, power of assimilating food, and power of reproduction. It moves, feels, grows, and multiplies. He should be taught that this minute organism exhibits the simplest forms of digestion, respiration, motion, feeling, and reproduction; that higher forms are organized by the multiplication of these units and that the phenomena of all higher forms of life are the same, only carried on under conditions of greater complexity. Though, as we study the higher species, the microscope may be used to show the structure of various animal tissues, it performs its prime educational office in the study of zoölogy by making clear to pupils the structure and functions of unicellular forms.

In botany a similar plan should be pursued. Beginning with a single celled plant, as Protococcus, study its life history. Then take a plant as Spirogyra in which the cells, though joined, are nevertheless easily discerned as individual cells. As in zoölogy the mount should be kept for some time available to the pupils, until each pupil has been allowed to study and make drawings of it. After this the larger cells of a moss leaf may be studied and then the layer on layer of cells as seen in heavier leaves. By this time the pupil will grasp the idea that a whole plant is made up of individual cells. However much the pupil may afterwards examine pollen grains and various prepared tissues, this preliminary work should and can be done in a class of good size even with a single microscope. If this work is done the pupil comes to understand the forms, structure, and functions of plants in their simplest manifestations, and thus is enabled to understand the complexity of higher forms more easily and more completely.

In physiology, as in zoölogy and botany, the first use of the microscope should be in the study of a single cell. The Amœba is for this purpose probably the best object for study. Here is an animal without stomach, heart, arteries, veins, lungs or brain, and yet it performs all the functions necessary for life, it assimilates food, grows and multiplies. After the pupil has studied this the teacher can easily explain how each part of the human body is composed of a multitude of

living beings called cells, each of which eats and grows like an Amœba, one collection of cells forming muscular tissue, another osseous tissue, etc. These various kinds of tissue can easily be examined if the school has provided the mounts. The teacher should also provide for the examination of blood corpuscles, in which the pupils always take great interest.

An experiment entirely practicable with only a single microscope is the examination of the circulation of blood in the web of a frog's foot. The teacher should secure the frog before cold weather and keep it in some place available for use.

Of course much more than has been suggested in this paper is desirable, but it seems wise to endeavor to influence teachers to do what is possible with the present equipment in the secondary schools of our State rather than to advise an ideal course which would require a full equipment.

A few years ago a microscope was rarely found in the secondary schools of this State. To-day nearly every school has at least one instrument, and several schools are contemplating the purchase of more. With the gradual introduction of better qualified science teachers into our schools the efficiency of the microscope for educational purposes will be more fully recognized, and its introduction will be more complete.

The educational value of the telescope is universally recognized, but its great expense will always prevent its liberal introduction into our schools. With the microscope, however, the case is different. Comparatively inexpensive, it is destined to become a large factor in the educational progress of the future, and one of the duties of this society should be to encourage and foster its use.

ARTHUR G. CLEMENT.

Method for Paraffin Infiltration.

During the past year I have employed a process for paraffin infiltration which has given me the greatest satisfaction; being practically free, at least in my hands, from the troublesome features of the methods which have been in general use. All laboratory workers are familiar with the difficulties involved in the manipulation of the paraffin oven and water-bath. The objections to which may be enumerated as follows:

First—The time required to establish the heat of the apparatus at the paraffin melting point.

Second—The difficulty in maintaining the proper degree of temperature while the tissues are infiltrating.

Third—The necessity of changing the temperature of the apparatus for paraffin of different melting points.

Maintaining the proper degree of temperature during infiltration has to me been the most troublesome of all the steps in paraffin technique. It is always desirable to infiltrate tissues with the paraffin at as nearly the melting point as possible, and this is extremely difficult to accomplish with the oven and water-bath, even when the best thermo-regulators are used.

The essential feature of the method which I wish to describe consists in

applying the heat to the upper surface of the paraffin and of such an intensity as to only melt the paraffin a sufficient depth to submerge the tissues to be infiltrated. The tissues, as will readily be seen, lie on the unmelted paraffin and recede from the heat if the heat increases and the paraffin melts deeper. Freezing of the paraffin about the tissues on lowering of room temperature has never been an objection to the method, as any ordinary change of temperature does not affect the depth of melting. The principle may be applied in a very simple way. Fill paraffin cups, preferably glass, full with melted paraffin and allow to solidify. Place the cups thus filled with solid paraffin under a copper plate which is supported over a flame by tripod or retort stand. The flame should be a suitable distance from the cups, and of such intensity as to melt the paraffin one or two cm. deep. It is best to allow the paraffin to reach a stationary depth of melting before placing the tissues in the cup for infiltration; one-half hour will be sufficient for this. Even this simple application will, with very little experience, enable one to manipulate the method with the most satisfactory results. Apparatus may be devised which will be more convenient than that which I have described. For class work I have had constructed an apparatus which accommodates twenty cups, ten for hard, and ten for soft paraffin. In this I used glass cups four cm. in diameter by five cm. deep. The copper plate swings on a hinge and may be lifted to expose the cups without moving them. In constructing a convenient device for this work, the principal suggestion that I would offer is to make the plate to swing or lift, thus rendering it unnecessary to move the cups when transferring the tissues.

Cleveland Homeo. Med. Coll. C. M. THURSTON.

New Technic for Staining the Tubercle Bacillus.

Various methods have been used for the staining of the tubercle bacillus, and all are more or less satisfactory. It is not my purpose to in any way allude in a disparaging tone to any of these methods, but to bring forward another method for staining the tubercle bacillus. Staining with carbol fuchsin and then treating the spread with a dilute solution of sulphuric or nitric acid, and then counterstaining with vesuvin or methylene blue, is one of the best methods.

Sudan III is a very uncertain stain, because of the different makes of the stain, and in my hands, and others, proved absolutely useless, not staining the bacillus at all.

This method was first brought forward by Dorset, who claims to have obtained a very good result when spreads where first stained with an alcoholic solution (88 per cent.), and then decolorizing with dilute alcohol, 70 per cent.

The peculiar reaction of the stain was, he claimed, due to the fat contained in the bacillus. Lately, I believe, he himself claims that all samples of the stain do not give the peculiar stain, his stain being one obtained from Merck's.

Further, the smegma bacillus, which is often mistaken for the tubercle bacillus, decolorizes entirely when treated in this way. The tubercle bacillus, as is well known, stains with all anilin dyes, and by Gram's method.

Anilin gentian violet is another very good stain, and when a spread is made and stained by the anilin gentian violet and then decolorized with a twenty-five per cent. solution of sulphuric acid, it is counterstained with vesuvin, which gives a very pretty picture; the tubercle bacilli staining deep violet, other bacteria and puss cells, brown.

The directions given in text-books and manuals for staining sputum are: Make a very thin spread upon a cover-glass, dry, fix, and stain. The trouble with these directions is, that most people make the spread entirely too thin, and nothing but a few cells are visible.

In making a spread of sputum make it moderately thick, so that when you dry the preparation you will have a good layer to stain.

The method I wish to publish was discovered accidentally. Prof. Coplin, while reaching upon a shelf above him, grasped a bottle which he thought contained dilute sulphuric acid, but it contained sweet spirits of nitre. He placed this upon the spread and obtained a very good result; it bleached perfectly. This was, I believe, some six or seven years ago. Since then I have been using it entirely for staining, or rather bleaching, specimens of sputum, tubercular pus or tissue, with very beautiful results.

Further, I have combined the sweet spirits of nitre and methylene blue with malachite green, Bismarck brown, and gentian violet. In this method the spread is first stained with carbol fuchsin for five or ten minutes; then the mixture is placed upon the spread, after the excess of carbol fuchsin is drained off. The stain is allowed to act one or two minutes washed with water, and if a green or blue color is not present, place the solution on again and wash with water. Usually one application of one or two minutes is sufficient to obtain a good result.

In specimens of urine, where so much granular debris is present, and in some specimens of old sputum, this method is especially applicable. The reason is that the nitre dissolves out all fatty, granular particles and leaves a clean cut, well defined field behind. The smegma bacillus is also decolorized with this stain.

Where the sweet spirits of nitre and the malachite green mixture is used, a beautiful contrast stain is obtained, green being the complementary color of red. In making up the mixture enough of the stain, malachite green or methylene blue in fifty per cent. dilute or saturated alcoholic solution is added to the nitre to make a deep green or blue fluid; the same with Bismarck brown.

Tissue containing tubercle bacilli can also be stained quite well by this method. A longer application of the counterstain (five minutes) is needed, however. After the counterstain has acted for this length of time, the specimen is washed in water, *nearly* dried, and then placed in carbol xylol two or three minutes to clear, and is then mounted in xylol balsam. The tubercle bacilli are stained red, the tissue a brown, blue, or green, according to the stain used.

Most observers claim that by heating the spread after carbol fuchsin is placed upon it, a better result is obtained than by staining in the cold. Personally, equally perfect results have been obtained whether the specimen is heated or not. The trouble when directions are given for heating is that too much heat is very often given the specimen, and the cellular elements are destroyed.

Another important step in staining the specimen is to be sure and wipe the *under* surface of the cover-glass clean, because (when the specimen is heated especially) the carbol fuchsin runs upon the under surface of the cover-glass and dries. If this is not wiped off clean, a red, blurred, imperfect preparation is the result.

The advantages claimed for this method are:

1. That it is easy to prepare.
2. That it gives a cleaner, better defined field.
3. That it does not destroy the tissue, as is sometimes the case with sulphuric acid.
4. That it acts more quickly and surely.
5. That it keeps indefinitely.

Jefferson Medical College. DR. RANDLE C. ROSENBERGER.

Labeling Cover-Glasses for the Identification of Sections.

In preparing a number of sections fixed to cover-glasses or slides, for examination, it is sometimes desirable to mark them in a way that will identify them after passing through the various solutions, and mounting. The following has given perfect results:

Incorporate in equal parts of egg albumen and glycerine enough lampblack to pigment it sufficiently. If prepared properly, this solution will flow readily from a steel pen on a cover-glass or slide, upon which may be written the number of the section. After writing the number, hold the slide or cover-glass over a flame until the numbers are dry. Sections may then be fixed to the glass thus labeled, and carried through any solution without fear of losing their identity.

Cleveland Homeo. Med. Coll. C. M. THURSTON.

COLLECTION OF BUTTERFLIES.—Preliminary arrangements for a collection of butterflies and moths may be made by gathering cocoons during the winter. They are found attached to twigs of trees or bushes, woven under angles of fences and stone walls, on the ground, protected by leaves, and some worms (?) bury themselves a little way under the ground before going into the quiescent state. The cocoons may be laid away until spring, or they may be kept where they will be warm, and will hatch much earlier, although the dryness of ordinary living rooms sometimes prevents the perfect development of the butterfly. An unused window enclosed with netting is a good place for the cocoons to hatch, and half a hundred butterflies are worth looking at. The pupæ of larvæ that bore in the ground should be kept in earth. Wherever the pupa is placed, care must be taken to leave plenty of room for the newly-hatched butterfly to spread its wings at once, otherwise they will harden without properly developing, and a dwarf butterfly will result.

Journal of Applied Microscopy.

L. B. ELLIOTT, EDITOR.

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IT IS perhaps no exaggeration to say that, to the popular mind, the microscope has little or no place outside the laboratory of the college professor, the original investigator, or the physician, and that it is an instrument the use of which involves the most exhaustive mental activity, and therefore limited in use to the trained mind. Few have seen in it the possibilities of a most excellent means of recreation, a most interesting and highly beneficial means of spending time that might otherwise be wasted.

He who wishes to forget for a time each day the cares of everyday life can find no surer or more profitable way than to seek a quiet place and there, with a good microscope, make the acquaintance of the invisible plant and animal world which surrounds him. Recreation of any kind, to be beneficial, must be a change from the ordinary, and must detract, completely, the attention from the strain of business pursuits. What could more effectually meet these requirements than to step, as it were, into a new world—a world as different as can be from the one we see around us, yet equally as beautiful and as full of activity. Few there are who do not wish to make the most of their time, and who do not seek to occupy their leisure moments in a way that not only brings relief from fatigue, but results most profitably to them.

It requires neither great expense nor a long period of preparatory training, before benefits from time spent with the microscope may be realized. Development of manufacture has brought the cost of good instruments within reach of the many, and they are no longer expensive luxuries to be possessed only by the few. It does not require an elaborate outlay to begin the work; the microscope alone, with a slide and a few covers, will suffice to introduce the beginner to numberless intensely fascinating subjects. Lack of technical training is not an impassable barrier to the use of the microscope, for with a few hints of caution as to care and use of the instrument, one may commence his observations at once. The microscope is only an aid to seeing, and the teeming life that fills every pond, ditch, and stream, and parts of flowers, insects, etc., need only to be brought under the lenses to be seen. It requires little or no skill to prepare for observation a plant hair of one of our common house plants; but this simple mount discloses the marvelous activity that is constantly going on in every living, growing plant. It is a simple thing to observe the circulation of blood in a frog's foot; yet what is more interesting and more apt to command one's entire attention?

Not only is the experiment, as a means of recreation, most successful, but the experimenter gains a knowledge of subjects which make the world around him more enjoyable, and he acquires a mental training which increases his ability to perform successfully whatever work he may pursue. A microscope in the house introduces a new element of culture, a far-reaching desire to become acquainted with other allied branches of science leading to the useful and the practical. Men and women who have had a microscope as a companion in youth can be relied upon to support and encourage liberal education and practical methods of instruction. The teacher who introduces the parents of his charges to the microscope, as a household necessity, lays the foundation for evenings spent at home, time spent in exploring forest, field, and brook, which might be wasted in far more harmful pursuits, and an awakening of the senses of observation and deduction in the healthy, normal manner meant by nature.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to Charles J. Chamberlain, University of Chicago, Chicago, Ill.

REVIEWS.

Harper, R. A. Cell Division in Sporangia and Asci. Ann. Bot. **13**: 467-525, Pl. 24-26, 1899.

This extremely careful piece of work deserves a place among the most important classics of cytological research. To one who believes that cytological phenomena are of importance in determining phylogeny this paper alone furnishes sufficient foundation for theories opposed to those of Brefeld and his school.

After a review of previous work, which is more or less unreliable on account of inadequate technique, Prof. Harper describes in detail the development of sporangia in *Synchitrium*, *Pilobolus*, and *Sporodinia*, in all of which the method of cell division was practically the same, and then deals with spore formation in the ascus of *Lachnea*.

The method of spore formation in the sporangium differs from that in the ascus. In the ascus the kinoplasmic fibers which radiate from the centrosome cut out an ellipsoidal cell, the spore, from the protoplasm of the mother cell. The daughter cells, thus cut out, do not contain all of the protoplasm of the mother cell of the ascus, but a considerable portion of this protoplasm remains as the epiplasm.

On the other hand, in all the sporangia mentioned, cleavage furrows start from the superficial surface of the mother cell or from the surface of vacuoles. The cleavage does not form uninucleate cells at once, but divides the mother cell into multinucleate masses, which in *Synchitrium* and *Pilobolus* are gradually split up until uninucleate protospores result, but in *Sporodinia* remain as multinucleate masses so that the spores of this form contain from ten to about fifty nuclei.

The development of the ascospores in *Lachnea* was found to agree essentially with the author's previous account of this phenomenon in *Erysiphe*.

Prof. Harper believes that the unlikeness in the method of spore-formation in the sporangium and ascus makes it impossible to assume any direct relationship between the Phycomycetes and the Ascomycetes. C. J. C.

Arnoldi, W. Beiträge zur Morphologie der Gymnospermen, IV. Was sind die "Keimbläschen" oder "Hofmeisters-Körperchen" in der Eizelle der Abietineen? (Preliminary announcement.) Flora. **87**: 194-204, Pl. 6-7, 1900.

Probably no one has examined well stained preparations of the oosphere of *Pinus* or other conifers without noticing the numerous nucleus-like bodies scattered through the cytoplasm. These structures were described by Hofmeister nearly fifty years ago as "Keimbläschen" (germinal vesicles), and he makes the statement that the archegonium of the vascular cryptogams differs from that of the gymnosperms in having only one nucleus (Keimbläschen), while that of the gymnosperms has many. Schacht,

who wrote at about the same time, regarded the structures as cell sap vacuoles, while Strasburger, at a considerably later period, regarded them as proteid vacuoles. Goroschankin (1883) made some study of their development, and found that they differ from the sap vacuoles and make their appearance before the cutting off of the ventral canal cell, and disappear during the formation of the embryo.

The present writer, with the aid of modern technique, has attacked the old problem of the origin and development of the bodies and finds that they are genuine nuclei. The nuclei of the cells of the tapetal layer immediately surrounding the oosphere put out amœboid processes which penetrate the cell wall, and soon the whole nucleus passes through the opening and into the cytoplasm of the egg, where they become more or less modified, so that while they bear a striking resemblance to nuclei they could not be positively identified as such except by tracing them back to their origin. Nuclei were also observed to pass from the next layer into the cells of the tapetal layer. The paper is only a preliminary announcement, but the stages figured are strong evidence in favor of the author's view. These bodies serve only for the nutrition of the embryo, and take no part morphologically in its development. C. J. C.

Merrell, W. D. A Contribution to the Life History of Silphium. Bot. Gaz. **29**: 99–133, Pl. 3–10, 1900.

It is well known that only the ray flowers in *Silphium* produce seeds. A study of the floral development shows that no ovules or even ovaries are formed in the disc flowers, while in the ray flowers the stamens usually remain as mere papillæ, although in a few cases flowers were found in which the stamens had reached the spore mother cell stage. The ovule is terminal and cauline. Eight chromosomes were counted in the nucleus of the megaspore mother cells and the same number was repeatedly counted in the dividing nuclei of the microspore mother cells.

The hypodermal archesporial cell gives rise to a row of four megaspores, of which the inner one germinates and becomes the embryo-sac. The growing sac ruptures the nucellus, the terminal portion of which remains perched on the micropylar end of the sac. The so-called tapetum surrounding the sac is derived entirely from the inner portion of the integument.

The most interesting part of the paper is that which deals with the pollen grain. In the mature pollen grain there are, besides the tube nucleus, two male cells which are greatly elongated and often have a remarkably spermatozoid-like form. The pollen tube enters the sac just beyond the nucellar cap, but further details of fertilization were not observed.

In the development of the embryo it is shown that the dermatogen, periblem, and plerome have separate initials, and that the root cap arises by proliferation of the dermatogen. C. J. C.

Hill, Thomas G. The Structure and Development of Triglochin maritimum, L. Ann. Bot. **14**: 83–107, Pl. 6–7, 1900.

This work was done under Professor Farmer at the Royal College of Science. Existing accounts of the structure of Triglochin maritimum are meager and misleading. The rhizome has a thick cortex, the outer part of which becomes lignified when old, and a central cylinder

through which are scattered vascular bundles of the concentric type with xylem outside; the very center of this cylinder also becomes lignified with age. A well marked endodermis separates the central cylinder from the cortex, and occasional cells, in the form of a cambium, developing from the pericycle, suggest "incipient secondary thickening." Leaf traces enter the cortex obliquely from the dense apical clusters of leaves, pass toward the center and then curve out to the periphery of the central cylinder. Many small bundles maintain a peripheral position throughout and receive bundles from the adventitious, acropetal roots; at the point of insertion of a root-bundle transverse commissures afford connection with ten or fifteen of these peripheral bundles. The root shows an outer, piliferous layer, exodermis, cortex, endodermis, pericycle and several collateral bundles arranged radially. The phloem element is reduced to a conspicuous companion cell and a sieve tube which touches on the endodermis, and not, as van Tieghem states, on the pericycle. The leaf and the stem each show a corrugated epidermis; in each the bundles are collateral, and in the leaf a very careful study reveals the bundles running from a linear position, considered transversely, in the sheathing base, to a somewhat grouped position in the tip. Many mucilaginous glands are developed in the axils of the leaves, and are cut off by thickening of cells at their bases. Persistence of meristem characterizes bundles of the peduncle.

The flower is arranged in six whorls of three as follows: perianth two, stamens two, carpels two. Careful observation establishes the acropetal appearance of the whorls in one, two, three order, and that the parts of the first, third, and fifth whorl appear in order from left to right; of the second, fourth, and sixth from right to left.

The development of the embryo-sac in a basilar ovule is normal; many antipodals occur; fusion of polar nuclei is delayed until fertilization; nuclear division in endosperm is without cell walls; the embryo is straight and stem tip lateral. The order of division in parts of the five-celled embryo separated by transverse walls is variable, but we are left in doubt as to the significance of the variation.

Chicago. JOHN E. WEBB.

De Vries, H. Sur la fécundation hybride de l' endosperme chez le mais. Rev. Gen. d. Bot. **12**: 129–137, Pl. 15, 1900.

De Vries began experiments in hybridizing corn as early as 1876, but the present paper deals with work done since 1898. It was already known that the sugar or starch of the kernel is contained in the endosperm and the various colors of the kernel, as red, purplish, etc., belong also to the endosperm. He found that when a variety with sugar in the endosperm was fertilized by pollen from a variety with starchy endosperm and also by its own pollen, some of the kernels contained starch and others sugar, but none were intermediate in character. When the variety with sugar in the endosperm was fertilized by pollen from the one with starchy endosperm, fertilization by its own pollen being prevented, the kernels of the hybrid contained starchy endosperm, a few only containing sugar.

When plants were raised from these starchy kernels and the stigmas were pollinated by pollen from the same plant, kernels were produced, some of which were filled with starch and some with sugar.

His conclusions are that each grain the endosperm of which shows the character of the male parent, has a hybrid embryo; and that each grain, the endosperm of which shows the character of the mother plant, has an embryo of the pure race and is therefore self-fertilized; that is, the hybridization of the embryo is always accompanied by the hybridization of the endosperm.

The writer believes that these phenomena find their explanation in the double fertilization as recently described by Nawaschin and Guignard, and that their results are corroborated by his work on double hybridization. C. J. C.

Küster, Ernst. Beiträge zur Kentniss der Gallenanatomie. Flora. 87: 117–193, 1900.

This paper is not confined, as its title might indicate, to the anatomy of galls, but is concerned also with their development and morphology. Most of the writer's attention has been devoted to galls produced by insects, while those which are due to myxomycetes, fungi, algæ, or worms are treated incidentally.

The principal results are the following: the simplest structure is found where the growth of the infected part is superficial, but widespread histological changes occur when there is growth in thickness. Galls which arise through the enlargement of cells already present are very primitive in their anatomical structure.

The epidermis withstands for the longest time the metamorphosing influence of the irritation, the mesophyll, cortex, and pith being more easily affected. The upper side of the leaf seems less liable to change than the lower. The most important change in the epidermis is the formation of hairs. Stomata often remain permanently open and, in some cases, genuine lenticels are formed underneath them.

Assimilative tissue is scanty, but mechanical tissue is usually formed when there is any growth in thickness. The vascular system is feebly developed.

The larva-chambers are surrounded by mechanical tissue, and in shape repeat the form of the galls.

In general, the cells of galls have the same form and arrangement as in normal tissues, but there appear in galls cell and tissue forms which are not found in normal parts of the same plant but are found in nearly related plants. However, many galls show cell and tissue forms which are not to be found in related plants.

Experimental plant physiology has not yet succeeded in producing new organs or new cell formations. Galls furnish the only evidence that a plant, through artificial, external influences, can produce new tissue forms or cell forms.

C. J. C.

Lidforss, B. Ueber den Chemotropismus der Pollenschläuche. (Vorläufige Mittheilung). Ber. d. deutsch. bot. Gesell. 17: 236–242, 1898.

The experiments described in this preliminary paper promise to add considerably to our knowledge of the movements of the pollen tube. *Narcissus tazetta* furnished material for most of the work.

If the pollen be placed in a 5 to 15 per cent. sugar-gelatine solution and a piece of stigma be added, the pollen tubes soon turn toward the stigma as is already known. Lidforss finds that organic acids—formic, acetic, succinic, lactic, tartaric, malic, etc.,—as well as amides, glucosides, and tannins, do not produce any undoubted effect upon the direction of growth of tubes. Diastase, however, produces

an almost immediate effect, and experiments show that it is the proteid constituent of the diastase which attracts the pollen tube. Further experiments show that carbohydrates and proteids are the substances which influence the direction of growth and indicate that the movement of the pollen tubes is for the purpose of securing nutrition.

The pollen of most Liliaceæ is more sensitive to mineral salts than *Narcissus* pollen, the same diastase preparation which attracts *Narcissus* pollen quickly killing the pollen of *Fritillaria*, but if the albumen be dialyzed it exerts a strong influence upon *Fritillaria* pollen. C. J. C.

CYTOLOGY, EMBRYOLOGY, AND MICROSCOPICAL METHODS.

AGNES M. CLAYPOLE.

Separates of papers and books on animal biology should be sent for review to Agnes M. Claypole, Sage College, Ithaca, N. Y.

CURRENT LITERATURE.

Porter, Carlos E. Memorandum de Zoolojia conpame e los ilimos adelantos de la ciencia. Pt. I, pp. 1–24, pl. 1. Valparaiso, imp. Gillet Urrida, 16, 1899.

The author gives a classification of 43 classes and 8 types of Sponges and Coelenterates in this number, and also a compendium of a manual now in press, planned for secondary work and covering one year of zoölogical study. Examples are chosen from among animals and plants of South America, especially Chili. The book is written in Spanish and is the first one of the kind ever published in that language. It is fully illustrated, chiefly from prominent zoölogies, comparative anatomies, and embryologies, but with some original plates. A summary of Claus's well-known standard work was at first intended, but the progress recently made required a more extended and critical treatment of the subject, especially in zoölogical classification. The base is, however, Claus's, and changes are noted according to the work of Vogt, Lang, Perrier, DeLage, Blanchard, Roule, and others, including Martinez i Saez, the authority in zoögraphy of vertebrates in the University of Madrid, to whose remarkable work the author has endeavored to conform in the classes, orders, and families of Vertebrates. The work is to be put in the hands of young students with the hope of affording help to them. A. M. C.

Ranvier, S. Des Clasmatocytes Archiv. D'Anat. Microscop. I, 3: 122–139, 1900.

The author refers to a recent acticle by Marchand (Ueber die bei Entzündungen in der Peritoneal höhle aufreten die Zellfermen. Extrait des comptes rendus de la Société Pathologique allemande), in which it is stated that the clasmatocytes are the connective tissue cells of the tunica adventitia of the blood vessels. He adds that these are fixed connective tissue cells and not lymphoid cells, because of the absence of amœboid movement. Ranvier refers to some past notes of his on the subject which Marchand clearly had not seen, but excuses the

oversight, since the earlier article was not illustrated. In this contribution these older notes are added and enlarged, and fully illustrated, to bring out the point under consideration.

Ranvier has studied clasmatocytes from the femoral aponeurosis of the frog's leg, *Rana esculenta;* in this tissue they have exact geometrical forms owing to their restricted limits. The processes of the external face of the cells are at right angles to those of the internal. This regularity renders the distinction of these cells from other kinds, as the lymphatic, very easy. After fixation with osmic acid for about three minutes, methyl violet 5 β colors the lymphatic cells a dark reddish violet, while the connective tissue cells are a clear blue. The process of preparation was as follows: a salamander is curarized. The mesentery is stretched and a few drops of osmic acid is used for a fixer, and violet 5 β for a stain; glycerine is added to preserve the preparation. The clasmatocytes are distinguished by clear blue nuclei and violet cytoplasm. They differ in size, form, and structure from ordinary leucocytes when fully formed. But it is difficult to say whether clasmatocytes are derived from leucocytes or whether leucocytes by special development become clasmatocytes. These latter cells from the mesentery of *Triton* are exceptionally large and have dendritic prolongations, which divide and subdivide, but apparently never anastomose. There are pigment cells present and the processes from ordinary connective tissue cells are found to anastomose with each other with the processes of pigment cells. The clasmatocytes of mammals were studied in the great omentum of the rabbit by means of the same methods as those used with Amphibia. The author says that in mammals these cells have been confused with the ordinary connective tissue cells by most histologists, as was done by the author himself in earlier works. But the comparative method in histology has solved the problem with the aid of new improved technique. Connective tissue cells are small, curved, branched, and anastomose by their prolongations. Clasmatocytes have granular processes that do not anastomose. The nuclei differ in the two classes of cells; those of the connective tissue are flat and regularly spherical or elliptical; those of the clasmatocytes are solid, elongate, and irregular. The granular substance in these cells is refractive and resembles eleidin in some respects, and makes it possible to recognize the cells in a membrane without much difficulty. The mesentery of the *Triton* was found good for experiments to show whether these clasmatocytes which develop from the lymphatic cells are, as well as those, endowed with power of amœboid movement. Under these conditions no spontaneous movements have been observed. They are especially motionless in the frog and in the small mammals, the rabbit, rat, and guinea pig. M. Marchand, repeating these experiments, came to the same conclusion, and inferred from this absence of motion that the cells were simple connective tissue cells, evidently not repeating Ranvier's work proving the transformation of leucocytes into clasmatocytes. One of the points made in this work, which appeared in the "Comptes rendus de l'Académie des sciences," was that leucocytes began their transformation into clasmatocytes by sending out long processes, which become fixed to the surface of the glass of the damp chamber in which the membrane is stretched, and attain great length. This

fact helps to explain the cause for the great variety of forms found among clasmatocytes.

The true form of clasmatocytes is a regular sphere varying in position according to certain conditions of the tissue as to resistance or irritation. These cells are leucocytes that have lost the property of motion, and have acquired that of elaborating within themselves a substance whose presence is recognizable by optical and histo-chemical reactions. This substance is finally freed in the meshes of the connective tissue, either in the plasma or serum. Its exact use is not, however, as yet known, but the author suggests a plausible hypothesis. The leucocytes are elements of the circulation; they are great carriers in the blood and lymph; they are as the other blood elements, organs of nutrition, and bring food to the tissues. It is then reasonable enough to suppose that these transformed leucocytes have the power of elaborating the granular substance found in them, which is, without doubt, of an albuminoid nature, as a reserve nutritive substance, so that clasmatocytes serve as the storehouses for albuminoids as adipose cells do for fats.

From the standpoint of pathology these cells have still more possible interests. With pus and suppuration, whatever may be the cause, there are present immense numbers of leucocytes. The source of these is variously ascribed, by Virchow to local connective tissue cell proliferation, by Cohnheim from the blood vessels by diapedesis. The blood is, however, incapable of providing such large numbers of cells, so that the lymphatic glands, the liver, bone, marrow, and spleen are all considered sources of supply; in addition to these, the author considers these clasmatocytes capable of serving in the same cause. In corroboration, certain simple experiments are given, which show the return of clasmatocytes to leucocytes. Injecting into the peritoneal cavity of the rabbit a few drops of a solution of silver nitrate, about three per cent., the following changes can be observed: In about twenty-four hours all the clasmatocytes of the great omentum have returned more or less to their first form, none present have the true clasmatocyte form. Many appear to have recovered their activity, judging entirely by their forms. The rest of the tissue cells show the ordinary effects of inflammation; the endothelial cells have assumed the appearance of connective tissue cells so closely as to be indistinguishable from these. But the connective tissue cells and clasmatocytes have undergone very different changes; changes that give them absolutely distinctive characters. As a result of these, numerous leucocytes are found which have clearly come from the spherical clasmatocytes.

Some experiments on the guinea pig are very suggestive. Six drops of a solution of silver nitrate (1–300) are injected into the peritoneal cavity of a guinea pig, and two days after, two cubic centimeters of vermilion suspended in normal salt solution. After twenty-four hours the animal is killed, and its omentum examined. The endothelial cells are globular, fusiform or stellate, and by the side of these on the surface are many leucocytes. Grains of vermilion are present in all the cells, but no clasmatocytes are to be found; all have been transformed into leucocytes. It is probable that the vermilion is not taken up by the clasmatocytes, but that leucocytes carrying them penetrate the membrane

and are transformed into clasmatocytes. Another experiment was tried to determine this point. After injecting two cc. of vermilion into the peritoneal cavity of a guinea pig, the animal is killed four days after in order to give the leucocytes time to penetrate in large numbers into the connective tissue layer of the omentum. There are in this experiment more clasmatocytes carrying vermilion grains than in the preceding cases; in general the clasmatocytes were hypertrophied, their nuclei more voluminous, their protoplasm vacuolated, and the cells increased in size as if there had been a general increase in secretory activity, due to the irritation present. A. M. C.

Allis, E. P. The lateral Sensory Canal of Polypterus. Archiv. Anat. Anz., **17**: 433–457, 1900.

The lateral canals of *Polypterus* are seen to present a condition representing perfectly normal development excepting in one case where fusion was found between the primary pores of the mandibular line. No primary pore in the entire lateral line system has been secondarily divided, and in this respect *Polypterus* presents a lower stage of development than either *Amia* or *Sepidasteus*. The mandibular pores unite as the symphysis of the mandibles and form a single median pore. The main infra-orbital canals unite on the top of the snout and are there enclosed in a purely dermal, median ethmoid bone. The primary tube and pore, normally formed in the median line, has disappeared as in *Amia*. The supra-orbital canal does not connect directly with its fellow of the opposite side, but anastomoses anteriorly and posteriorly with the main infra-orbital canal. The supra-temporal commissure connects with its fellow of the opposite side, and is probably the exact homologue of the cross commissure in *Amia*. Its lateral terminal pore fuses with the twelfth infra-orbital to form a double pore. The pre-percular canal is continuous with the mandibular canal, but does not join at its dorsal end. The main infra-orbital anterior and middle dorsal head lines of pit organs are found as in *Amia*, but no signs of a posterior were seen. The anterior and middle head lines correspond closely to those of *Amia*. There are horizontal and vertical cheek lines of pit organs and a gular line, but no trace of a mandibular line similar to that of *Amia* was found. There are three sensory lines on the body; the most important of these lines farthest ventral on the body of the fish, and probably corresponds to the main lateral line of other fishes. The farthest dorsal apparently corresponds to the dorsal body line of *Amia* and certain other fishes. The third line is less complete than either of the others, lies between them, and may correspond to the accessory lateral line of *Amia*. A. M. C.

NEUROLOGICAL LITERATURE.

Literature for Review should be sent to JOURNAL OF APPLIED MICROSCOPY, Rochester, N. Y.

Harris, H. F. Case of Diabetes Mellitus, quickly following Mumps. Repr. from Bost. Med. and Surg. Jour.

The writer's attention was called by this case to a possible relation between morbid conditions of the salivary and pancreatic glands. Microscopic examination showed changes in the tissue of

both glands and in the tissue of the lungs, intestine, lymphatic glands, and kidneys.

The pancreas and salivary glands showed irregular thickening of the trabeculæ which bind the lobules together. Usually the substance between the acini was unchanged, but frequently it was thickened, and in some cases the acini were crowded out and replaced by white fibrous tissue without any elastic fibers among them. The excretory ducts of the glands were much reduced in size and often distorted.

The trabeculæ of the lymph nodes in the glands showed a decided thickening and large cells measuring from 9 to 10 μ were found in the periphery and through their substance. Many of the cells were without nuclei and had finely granular protoplasm that stained intensely with acid dyes. These cells were apparently degenerating.

Scattered through the lung substance were numerous miliary tubercles with caseous center surrounded with walls of fibrous tissue containing fibroblasts and some giant cells. In the majority of cases the tubercles seemed to have begun in the bronchial tubes, which contained many polymorpho-nuclear leucocytes.

E. M. B.

Loeb, Jacques. Warum ist die Regeneration kernloser Protoplasmastuecke unmoeglich oder erschwert? Archiv. f. Entwickelung smechanik der Organismen. 8: 689–693, 1899.

Dr. Loeb believes that the nucleus is the organ chiefly concerned in the oxidation of living substance, and that portions of protoplasm lacking a nucleus cannot regenerate because they do not have enough oxydizing power, and therefore slowly suffocate. Enucleated pieces of algæ may live several weeks, but the cells of algæ contain chlorophyll, and can assimilate carbonic acid from which oxygen is freed, and this condition is quite different from that of infusoria fragments. Lack of oxygen will undoubtedly cause solid elements to become fluid. Four years' observations have shown that the walls of the blastomeres of ctenoblabrus become fluid if the supply of oxygen is cut off, and further observations made by Budgett in Dr. Loeb's laboratory show that the body walls of Infusoria break down and become fluid when deprived of oxygen, and that certain poisons produce a similar effect.

E. M. B.

Stead, J. E. Microstructure of Alloys. Metallographist, 2: 314–334, 1899.

The writer describes the crystalline structure of alloys of antimony and tin, antimony and copper, and copper and tin, of varying composition, with the purpose of determining the proportions of the metals present by the appearance under the microscope. The crystalline structure of the eutectic of antimony and tin appears to be the same as that of tin itself, but at the joining of the crystallite forms in the eutectic there is a little more antimonite than in the central portions. All compounds of tin with less antimony than 7½ per cent. crystallize in the same forms. The forms of the crystals begin to change in the neighborhood of 40 per cent. Sb and 60 per cent. Sn; in alloys containing between 45 per cent. and 55 per cent. of antimony the crystals are thick plates instead of well-defined cubes. In slowly cooled alloys with from 57 per cent. to 80 per cent. of Sb the trains of crystallites present in alloys with from 51 to 57 per cent. of Sb change to

more or less symmetrically shaped crystals. At 90 per cent. the crystals are closely crowded and unsymmetrical, and as 100 per cent. is approached the crystals come closer together, so that very little of the second eutectic comes between them.

Similar detailed descriptions are given of the other alloys. E. M. B.

Edes, Robert T. Temperature and Rhythm. Bost. Soc. Med. Sc. 4: 39-42, 1899. Some very curious relations existing between temperature and rhythm are recorded. The rate of the chirping of the tree cricket seems to be correlated with the temperature of the atmosphere. At 44° the insect is silent and the chirping increases at the rate of four chirps per minute for every degree Fahrenheit up to 160° as tested. A similar relation has been found between the rapidity of the pulse and temperature.

Within the limits of from 87° to 41° C, with a pulse of 79 to 110 in cases of typhoid fever, the rate of increase is about ten beats to a degree Centigrade, or five and one-half to a degree Fahrenheit; then it becomes lower, then higher.

In general it seems that the simpler the organization, the closer the relation between rhythm and temperature, almost exact correspondence in the insect, then the rodent with smooth brain and cut vagus giving almost as regular a line, then variations within much wider limits in the dog with its highly organized cerebrum even after the nerves leading to the heart have been cut. The varying action of temperature on the pulse is probably due to the varying susceptibility of the vaso-motor system.

Observations made by Cleland on the chick showed the effects of heat on the embryonic heart to be the same as on the fully developed heart supplied with ganglia. E. M. B.

NOTES ON RECENT MINERALOGICAL LITERATURE.

ALFRED J. MOSES AND LEA MCI. LUQUER.

Books and reprints for review should be sent to Alfred J. Moses, Columbia University, New York, N. Y.

Breusing, Eduard. Untersuchungen über Breithaupt's Manganocalcit (Agnolith Breusing). Neues Jahrb. f. Min. Geol. u. Pal. Berlage Bd. 13: 265-330, 1900. The material which Werner labeled *faserige Braunspath Wasserbrukker Kluft zu Windschacht bei Schemnitz* was, in 1847, named by Breithaupt, *Manganocalcite*, on the strength of an analysis published by Rammelsberg. The material was considered to bear about the relation to ehodochrosite that aragonite does to calcite, that is, to be an orthorhombic carbonate of manganese with some lime, magnesia, and iron.

Professor Krenner, in 1883, believed that the cleavage indicated a hexagonal material, and at his request samples were sent from Freiberg to Des Cloizeaux for optical examination, and to Winkler for chemical examination, with the sur-

prising results that the material sent proved to be a triclinic silicate of about the same bases.

It was practically accepted that some blunder had been made, such as mixing the labels, or determining some associate rather than the same material analyzed by Rammelsberg.

In 1886 Rammelsberg published a second analysis, making the manganocalcite a mixture of silicate and carbonate.

Breusing has spent a year in a careful study of all the correspondence on the subject; has reanalyzed the specimens of Werner at Freiberg, and later obtained from Berlin Museum the very specimen of Rammelsberg and analyzed it; has carefully verified the optical determinations of Des Cloizeaux, and finds that all the Rammelsberg, Werner, Des Cloizeaux, and Winkler specimens are the same material, and finally proves that the faserige Braunspath of Werner, called manganocalcite by Breithaupt, consists principally of a triclinic silicate with more or less finely distributed carbonate, probably dolomite.

As the name manganocalcite was given in error to a wrongly determined species, he proposes the name *Agnolite*, from the Greek, signifying mistaken stone. The description of *Agnolite* would be as follows:

Agnolite—$H_2 Mn_3 (SiO_3)_4, H_2O$. Triclinic—An acid metasilicate of zeolite group near Inesite. Luster, vitreous; color, flesh, red to rose. H. about 5; G. 3.054 to 3.067. Occurring in rounded aggregates of radiating fibres and columns, with carbonated quartz, galenite pyrite, chalcopyrite, and often enclosing black particles of, probably, psilomelane or braunite. Cleavage good in direction of fibres. $2 E = 141°37$ for red light $\rho > \nu$.

Found near Schemnitz, Hungary, as stated. A. J. M.

Schwarzmann, M. Krystallophoto grammetrie. Neues Hilfsverfahren bei der Krystallmessung. Neues Jahrb. f. Min. Geol. u. Pal. 2: 1-38, 1900.

The obtaining of satisfactory measurements from crystals with curved or irregular faces and vicinal planes, and the study of the light figures of etched faces has always been a difficult task which, with the two circle goniometer, was accomplished by the reading of angles for a number of points of the reflex.

The author describes in detail a method which consists in brief in the photographing of the reflected image in a definitely oriented camera, and calculating the direction of the face normal from measurements made on the photographic plate. Two coördinates only are needed to determine the *direction* of the normal, and these are obtainable from one plate.

The method is purely supplementary to ordinary crystal measurement by reflection, and in no sense replaces it, but is limited to faces (curved, etched, facetted, etc.) which within a moderate angle possess numerous reflecting points.

Four methods are given differing in detail, but the general scheme may be judged by a concise description of Method I.

An ordinary horizontal circle goniometer (Fuess No. 2, for instance) with movable telescope and fixed collimator is adjusted with the telescope at right angles to the collimator. A small camera with rectilinear objective, say 25 cm. focal length and enclosing an angle of 40°, is adjusted directly opposite the

telescope. The camera permits slight degrees of rotation about horizontal and vertical axes, and slight movements of translation.

The details of adjustment in these positions cannot here be given, but if correctly made so that the telescope is accurately opposite the camera and at right angles to the collimator, then the reflection which is bisected by the cross hairs of the telescope must come from a face the normal to which is midway between the axes of telescope and collimator, or say at —45°. If the crystal is then turned 90° exactly, that is, until this normal is midway between the axes of the collimator and the camera, the reflection from the face will fall exactly in the center of the sensitized plate. At the same time reflections from other points will fall in definite other positions on the sensitized plate.

By measuring the angular coördinates of the different images with reference to the center, and by appropriate formulæ given at length, the face normals are calculated, and also the curves in the plate which correspond to definite crystal zones. A. J. M.

Kipping, F. S. and Pope, W. P. Enantiomorphism. Jour. Chem. Soc., London, **73**: 606, 1898.

The natural classification of enantiomorphous substances into two divisions given:

(*a*) Substances consisting of enantiomorphous chemical molecules, conditioning circular polarization in the amorphous or liquid state, and in the crystalline condition producing right or left rotation, but not partly the one and partly the other.

(*b*) Substances in which the enantiomorphism is purely one of arrangement of the chemical molecules in the crystalline structure, not being, of course, optically active in the amorphous or liquid state, but producing rotation of the plane of polarization in crystals; there being no *a priori* reason why this rotation should be either right or left.

Record given of experiments made on sodium chlorate crystals. The authors conclude that: a substance (only enantiomorphous in the crystalline state) crystallizing under perfect conditions will develop, on an average, an equal sum of right and left rotating crystals; but that the average ratio of the right and left rotating crystals may be made to differ from unity by introducing into the crystallizing solution a substance which is enantiomorphous in the amorphous state. L. McI. L.

Majorana, Q. Diamond, on Reproduction of. Rend. della R. Acc. dei Lincei. **6**: 141, 1897.

High temperature and great pressure are needed to produce diamonds (density 3.5) from amorphus carbon (density 2). Pieces of carbon are heated between the poles of an electric arc, and are fixed to a small steel piston-rod, which, by means of an explosion of gunpowder, is forced into a cavity in a steel block. The apparatus can withstand a pressure of 5,000 atmospheres.

The resulting mass (density 2.28) is reduced by Berthelot's method, as modified by Moissan, to some small particles, having the density, hardness, and crystalline structure of diamond, and being unaffected by acids.

G. D'Achiardi. Analcite, Optical Anomalies of, from Montecatini. Proc. Verb. della Soc. Toscana di Sc. Nat. **10**: 267, 1897.

Crystals have form (211), sometimes associated with cube faces. Sections parallel to (100), (111), and (211) were examined under the microscope.

Observations were in agreement with those of Ben Sande, Brauns, and Klein, showing each crystal to be composed of twenty-four monoclinic individuals, having for bases the faces of the icositetrahedron. Sections from the middle of the crystal were isotropic.

Author concludes that the optical anomalies are due to loss of water, probably the last phase of the crystallization.

Hillebrand, W. F. Mineralogical Notes. Analyses of Tysonite, Bastnäsite, Prosopite, Jeffersonite, Covellite, etc. Am. Jour. Sci. iv, **7**: 51, 1899.

TYSONITE and BASTNÄSITE, from Cheyenne Mt., near Pike's Peak, Colo., gave analyses proving the correctness of the previously assumed formulæ: $R''' F'_3$ for tysonite and $R''' (F' CO''_3)$ for bastnäsite. The tysonite showed in the blast the lithium red line, but analysis revealed only a trace.

PROSOPITE, from Dugway Dist., Torvel county, Utah, found associated with fluorite and silver; has pale green color (due to copper stain) and was formerly supposed to be variocite. G=2.87 at 21°C. H.=4.5.

Al	Ca	Mg	K	Na	Cn	F	H_2O	quartz+O.
20.08	17.55	trace	0.12	0.32	0.17	28	14.24	19.52=100.00

Conclusions drawn from analysis not altogether proven, on account of unsatisfactory conditions.

JEFFERSONITE, from Franklin Furnace, N. J., has rich, deep brown color; lamellar structure, due to pronounced cleavage or parting; brilliant lustre on cleavage surfaces; H about 5.5: G=3.39 at 21.5°C

SiO_2	Al_2O_3	Fe_2O_3	MnO	ZuO	CaO	MgO	Na_2O	K_2O	H_2O
51.70	0.36	0.37	7.43	3.31	23.60	12.57	0.12	tr.	0.65=100.14

Yielding metasilicate formula, $R'' SiO_3$.

The mineral fuses with difficulty a light colored, blebby glass, and differs in color and composition with hitherto published data.

L. McI. L.

NEWS AND NOTES.

A SPIDER COCOON.—A cocoon of spider's eggs kept under a low power lens forms an interesting object. The part supporting the lens should have glass sides to prevent the escape of the spiders when they hatch, or the lens may be placed over a wide-mouthed bottle, or a small beaker. The growth of the spiders can be watched from day to day and a study made of their cannibalistic habits, and an application made to the doctrine of the survival of the fit.

Living caterpillars may be sent through the mails if provided with a little of their food plant. Breathing holes are not necessary; in fact, the larvæ stand the journey better in a tight box in which the food plant will not dry. A strong tin

box is best, and if several species are sent it is a good plan to divide the box into compartments to protect the caterpillars from each other. Some aquatic larvæ may be transported very well if packed in damp sphagnum moss.—Bull. N. Y. State Museum, Vol. 6, No. 26, 1899.

Many entomologists use naphthalin in some form as a protection for collections of insects. If the heated head of a pin is pushed into a naphthalin ball, the ball will adhere to it, and can then be fastened into the cork lining of any insect case.—Bull. N. Y. State Museum, Vol. 6, 1899.

Dip Net.—Those wishing to collect water insects will find a shallow net of coarse material much more convenient than the ordinary butterfly net, because the mesh of the latter is too fine to permit moving it rapidly through the water. —Bull. N. Y. State Museum, Vol. 6, No. 26, 1899.

Relaxing Insects.—It frequently occurs that before insects can be permanently mounted, they become dry and unsuitable for mounting. If such specimens are put on paper or a piece of cork in a closed jar with moistened sand or a damp sponge, and allowed to remain, from a day in the case of very small insects to several days for the larger forms, they can be spread very well. The specimens should not be left in the jar too long, as they are liable to mold. A few drops of carbolic acid will prevent fungus growth.—Bull. N. Y. State Museum, Vol. 6, No. 26, 1899.

Stain to Demonstrate the Coleoderm of Diatoms.—Place a couple of drops of water containing diatoms on a cover-glass, and when they have adjusted themselves to the glass, add three drops of a solution made of 5 g. Bismark brown and 1 gram tannic acid dissolved separately and added to one liter of distilled water.

Stain half an hour and wash by carefully dipping the cover into a glass of water.

Next, stain for half an hour or an hour in Gruebler's aqueous eosin diluted with an equal quantity of water, and finally wash and mount in very weak formalin. The diatoms will lie against the cover-glass, ventral side uppermost, in the best position for study.

To show the presence of organs functioning as pseudopodia, living diatoms are placed in an emulsion of carbon-black water-color rubbed up in water. Coleodermic masses at the corners become apparent, especially in front, where a U-shaped clear space precedes the diatom.—Observations on Errant Frustulis of Eunotia major. T. Chalkley Palmer.

To Remark Old Burettes, etc.—Make a paste of plaster of Paris and water and add red lead, Prussian blue, or bone black according to the color desired, and rub the paste into the etched figures on the glass. White lead is used for the white markings on graduates and other glassware for chemical or pharmaceutical use.

Notes on Fish Embryology.

Thymallus signifer, the American grayling, has transparent ova in which development may be easily watched.

The Yellow Perch (Perca flaveus) is common in ponds and streams, and its spawn may be obtained in March and April. Ova are usually deposited at night in a grayish, gelatinous tough string which swells up in the water and hardens after fertilization, forming a long, hollow body, with transverse folds like the sides of an accordion. The cavity of this egg-mass communicates with the outside by occasional small apertures in the walls, so that water circulates around the eggs and ærates them with any slight motion.

They are easily developed in aquaria furnished with running water, as their weight is sufficient to keep them down. An occasional increase in the rapidity of the current will free the eggs from sand and sediment. During the later developmental stages, the aquarium must have a cheese-cloth strainer to prevent the escape of the fry. Ova should be kept at a temperature of 44° to 48° F.

Fixing Methods for Fish Ova.—Perenyi's fluid gives good results for fish eggs that are to be sectioned. The yolk contracts from the blastoderm, but better preparations may be obtained by killing in acetic acid, or acetic and osmic, and mounting directly in glycerine.

Prepare ova of the Salmonidæ by cleaning in one per cent. osmic acid for a few moments until they become light brown, then place in Muller's fluid in which they may be opened with fine scissors. The central, vitelline mass coagulates in the osmic acid, but dissolves in Muller's fluid, simplifying the taking out of the solidified germ for examination. If sections are to be made, the embryos should be left in Muller for several days and dehydrated in 90 per cent. alcohol followed by absolute.

Fish eggs may be fixed for ten minutes in Kleinenberg's solution to which 10 per cent. acetic acid has been added. After fixation, open them in water containing 10 per cent. acetic acid to dissolve the vitellus, leave for a few hours in a pure solution of Kleinenberg and dehydrate in alcohol.

Methods for Pelagic Fish Eggs.—Place the ova in a watch-glass with a little sea water, and add an equal volume of one-half per cent. osmic acid. Leave five or ten minutes, wash quickly in water and transfer to a solution made up of equal parts of one per cent. chromic acid and 1.4 per cent. platinic chloride ($Pt\ Cl_4$) for one to three days. The blastoderm may then be freed, and after washing several hours, dehydrated.

Differentiations may be shown with this method as early as the 16-cell stage, and in later stages distinctions may be shown between central and peripheral cells, and in this way the whole history of the origin of the parablast may be traced.

A modification of this method consists in using a solution of equal parts of one per cent. chromic acid and twenty-five per cent. platinum chloride. The fluid prevents over-blackening by the osmic acid. The egg membrane should be pricked and the egg transferred to alcohol.

Perenyi is good for the later stages.

Nitric acid (20 per cent.), ...	3 parts.
Chromic acid (1 per cent.), ...	3 "
Absolute alcohol, ...	4 "

Journal of Applied Microscopy.

VOLUME III. JULY, 1900. NUMBER 7

Physiology in the Peter Cooper High School, New York City.

I. PLACE OF PHYSIOLOGY IN THE CURRICULUM.

FIG. 1.
CLASS AT WORK IN THE LABORATORY.

Physiology is studied in all the courses throughout the first year, and in most of the classes the subject has an assignment of two fifty-minute periods each week. Instruction is also given in botany or zoölogy three periods per week throughout this first year.* The pupils, therefore, pursue their biological studies

*See note on page 931.

before they have taken up the courses in physics and chemistry. The number of boys and girls in each division is usually about thirty-five.

II. PHYSIOLOGICAL LABORATORY.

The physiological laboratory is situated in the northeast corner of the school building (Fig. 8). Its dimensions are twenty-one by twenty-seven feet, and it is lighted on two sides by large windows. The greater part of the floor room is required for the ten laboratory tables, each designed for the use of four pupils (Fig. 9). The tables are made of whitewood, the lower portion being finished with shellac. The top is soaked successively in solutions of logwood and of iron, and melted paraffin is then rubbed into the wood with a hot iron. This treat-

FIG. 2.
PHYSIOLOGICAL LABORATORY.

ment gives a dull black finish that is not affected by acids, alcohol, or stains. Unlike varnished desk-tops, these do not reflect light into the eyes of the pupils.

The desks are arranged in the room so that the pupil faces the north windows when doing laboratory work (Figs. 1, 2, and 8). He therefore has the best possible light for the microscope and for the object he is studying. Revolving chairs are used, which can be easily raised or lowered according to the needs of each pupil. When recitations are held or class demonstrations given, the boys and girls turn their chairs to face the instructor, and since the desks in this position are on the right side of the pupil, notes can be taken easily. By this arrangement it is possible to convert the laboratory into a recitation room without

any loss of time. Half of a fifty-minute recitation period may be devoted to microscopic work, then the specimens may be pushed aside and the attention of the class directed to recitation.

III. LABORATORY EQUIPMENT.

The seven teachers of biology use in common the apparatus and supplies belonging to the department, a partial list of which follows: thirty-six compound microscopes, each provided with rack and pinion, fine adjustment, double nose-piece, iris diaphragm, two eye-pieces, and a two-thirds inch and a one-sixth inch objectives; magnifiers and dissecting microscopes; steam sterilizer, hot air sterilizer, and Petri dishes for bacteriological work; fourteen specially prepared

FIG. 3.
CLASS STUDYING AT AMERICAN MUSEUM OF NATURAL HISTORY.

wall-charts (Fig. 6); twenty-five prints of photomicrographs from each of forty-five negatives (Fig. 7); skeletons and dissected preparations (Figs. 4 and 5); glassware; chemicals; reference books.

IV. AIMS OF THE COURSE IN PHYSIOLOGY.

The principal aims of the course in physiology are these: (1) to give each pupil some knowledge of the normal functions of the organs in his own body; (2) to make him so familiar with the structure of his organs and tissues that he will get this understanding of their function (anatomy is, therefore, subordinated to physiology); (3) to acquaint the pupil, so far as time allows, with general biological principles involved in nutrition, growth, relations of animals and plants, and evolution.

V. OUTLINE OF THE COURSE.

A. Introductory study.

1. Lessons in chemistry.

a. Experiments in burning a match to familiarize the pupil with the common elements and compounds, and with the process of oxidation.

FIG. 4.
SKELETONS AND ANATOMICAL PREPARATIONS.

b. Experimental study of oxygen and nitrogen to show the composition of air, and the uses of each ingredient.

c. Discussion of the chemical composition of the human body.

d. Acid and alkaline reactions.

2. Study of living substance. (Protoplasm.)

a. General structure of the body. Enumeration of the organs and tissues with their functions.

b. Cells; their structure and functions. Intercellular substance (cartilage, bone). Some of the properties of protoplasm.

B. Study of foods.

1. Laboratory work.

a. Experiments at home.

(1) Testing various foods for (a) starch, (b) grape sugar, (c) proteid, (d) mineral matter, (e) fats and oils. (Iodine, Fehling solution, and test tubes loaned from the school supply.)

(2) Analysis of (a) flour, (b) milk.

(3) Conversion of starch into grape sugar by saliva.

FIG. 5.
ANATOMICAL PREPARATIONS.

b. Determination of percentage of water in foods.

c. Study of the charts and tables in Atwater's "Foods: Nutritive Value and Cost."

2. Text-book.

a. Kinds of food.

b. Uses of food in the body.

c. Stimulants: their use and abuse.

3. Applications.

a. Economy of foods.

b. Dietaries and dietary standards.

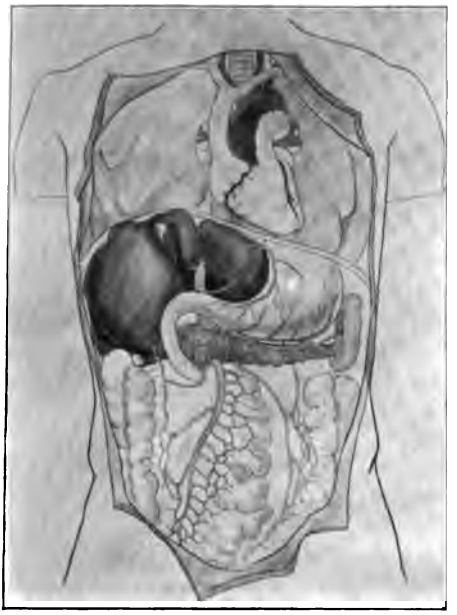
c. Cooking of foods.

C. Study of digestion.
  1. Laboratory work.
    a. Study of pupil's own mouth (see outline on page 927.)
    b. Drawing of human teeth.
    c. Drawing of alimentary canal of frog.
    d. Demonstration of the principles of osmosis. Application of these principles to absorption.
    e. Digestion of (a) starch, (b) proteid, (c) fats, (d) mineral matters.
  2. Text-book.
    a. Structure and function of (a) teeth, (b) tongue, (c) throat, (d) stomach, (e) intestines, (f) liver, (g) pancreas.
    b. How food becomes blood.
  3. Applications.
    a. Care of the teeth.
    b. Hygienic habits of eating.

D. Study of the blood.
  1. Laboratory work.
    a. Observation of bottles of (a) clotted blood, (b) defibrinated blood, (c) blood fibrin.
    b. Tests for fats, proteid, and mineral matter in serum.
    c. Effect of oxygen on blood.
    d. Drawing of blood corpuscles (compound microscope).
  2. Text-book.
    a. Composition of blood.
    b. Uses of each ingredient.

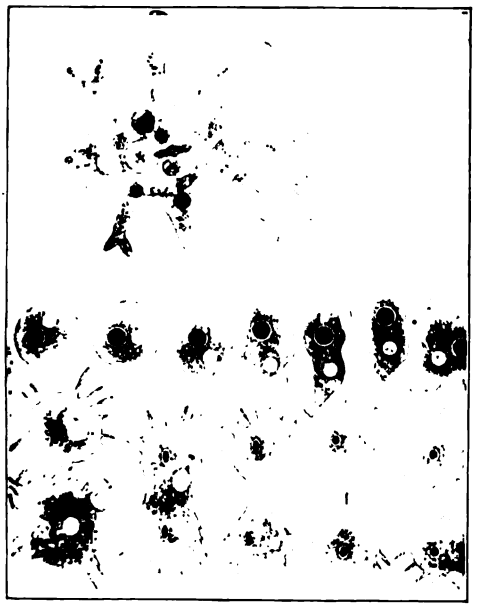
E. Study of the skeleton (including joints).
  1. Laboratory work.
    a. Notes taken from the articulated human skeleton.
    b. Drawings made of a vertebra and of a longitudinal section of a long bone. Cross sections of a long bone and of a rib.
    c. Experiments at home: (a) burning of bone; (b) soaking of bone in acid (furnished from school supply); (c) boiling of bone.
    d. Classification made by pupil of the joints in his body.
  2. Text-book.
    a. Position, shape, and uses of the different bones.
    b. Gross structure of bones.
    c. Structure of joints.
  3. Applications.
    a. Effect of clothing (shoes, corsets) on the skeleton.
    b. First treatment of fractures, dislocations, sprains.

F. Study of the muscles.
  1. Laboratory work.
    a. Dissection of lean meat.
    b. Demonstration of nerve-muscle action of frog.
  2. Text-book.
    a. Structure and uses of voluntary and involuntary muscle.

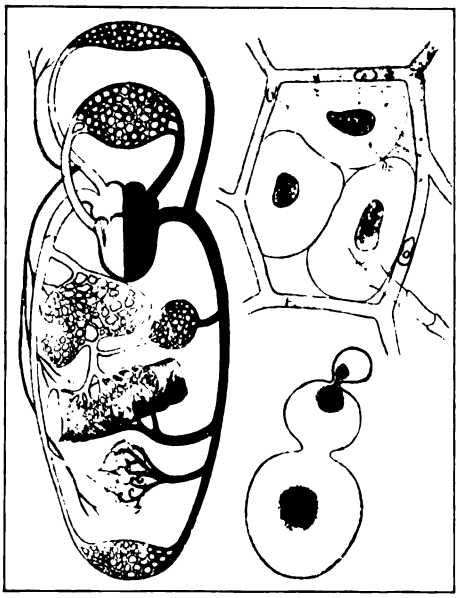


ORGANS OF CHEST AND ABDOMEN.

LONGITUDINAL SECTION OF HEAD.



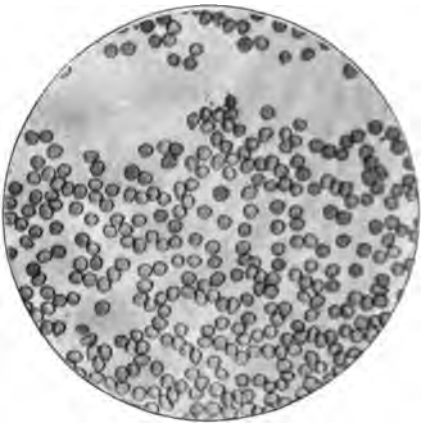
AMŒBA. LOCOMOTION AND CELL DIVISION.



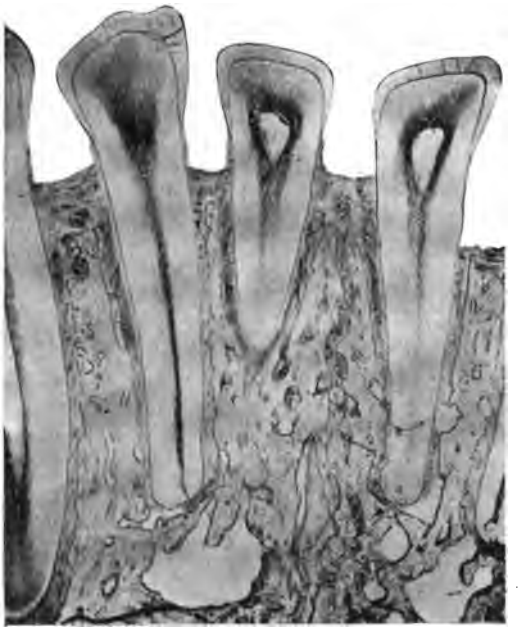
BLOOD CIRCULATION. BUDDING YEAST CELL.

FIG. 6.
WALL CHARTS.

HUMAN VOLUNTARY MUSCLE.
ARTERIES INJECTED. X 175.



HUMAN BLOOD CORPUSCLES.
RED, WITH ONE LEUCOCYTE. X 220.



UPPER JAW OF CAT WITH TEETH IN SITU.
X 20.

TRANSVERSE SECTION SMALL INTESTINE OF
MOUSE, INJECTED.

FIG. 7.
PHOTOMICROGRAPHS.

b. Nerve control of muscle.

3. Applications.

a. The hygiene of exercise.

G. Study of the heart and the circulation.

1. Laboratory work.

a. Demonstration of the beef heart.

b. Demonstration of the action of frog's heart.

c. Demonstration of flow of blood in the tail of a tadpole (compound microscope).

2. Text-book.

a. Structure and function of (a) pericardium, (b) auricles, (c) ventricles, (d) semilunar valves, (e) mitral valve, (f) tricuspid valve.

b. Structure and function of (a) arteries, (b) veins, (c) capillaries.

c. General course of the blood in the pulmonary and systemic circulation (details omitted).

d. Changes in the composition of the blood in the pulmonary and systemic capillaries.

3. Applications.

a. Treatment of cuts and bruises.

b. Prevention and cure of "colds."

c. Cause and cure of fainting.

H. Study of respiration.

1. Laboratory work.

a. Drawing of lungs, wind-pipe, and larynx of calf.

b. Demonstration of action of lungs from model.

2. Text-book.

a. Structure and function of (a) lungs, (b) diaphragm, (c) larynx.

3. Applications.

a. Principles underlying ventilation.

b. Relation of clothing to respiration.

c. Hygienic habits of breathing.

I. Study of excretion.

1. Laboratory work.

a. Drawing of kidney of pig.

2. Text-book.

a. Structure and function of (a) kidneys, (b) skin, (c) lungs (in review).

b. General review of the processes of nutrition: (a) foods, (b) digestion, (c) absorption, (d) circulation, (e) assimilation, (f) oxidation, (g) excretion.

3. Applications.

a. Care of skin.

b. Treatment of burns.

J. Study of nervous system.

1. Laboratory work.

a. Drawings of brain and spinal cord of sheep: (a) outside view, (b) section.

b. Experiments: (a) reflex action, (b) various sensations.

2. Text-book.
   a. Structure and function of (a) spinal cord, (b) brain, (c) nerves, (d) end organs. (Special senses omitted).
3. Applications.
   a. Hygienic habits of study.
   b. Effect of exercise and sleep on the nervous system.

K. Supplementary work in physiology (topics studied so far as time allows).

1. Microscopic study of (a) bone, (b) muscle, (c) various kinds of epithelium, (d) nerve cells and fibres.
2. Study of yeast (a living cell).
   a. Experimental study of the effect on the growth of yeast of (a) heat and cold, (b) light and darkness, (c) various kinds of foods.
   b. Fermentation in bread and beer making. Preparation and properties of alcohol.
   c. Microscopic study of yeast.
3. Study of bacteria.
   a. Experiments in souring of milk, and in decay of animal matter.
   b. Culture of bacteria colonies.
   c. Sterilization and disinfection.
   d. Practical questions in bacteriology. Relation of bacteria to disease.
   e. Microscopic study of bacteria.
4. Comparative study of vertebrates.
   a. Dissection of the frog.
   b. Study of the skeleton and the teeth of vertebrates at the American Museum of Natural History. (See Fig. 3 and outline, page 930.)
   c. Study of movements and habits of the fish at the aquarium, and of the animals at the Zoological Gardens.

VI. METHODS EMPLOYED.

From the preceding outline it will be seen that the pupil begins the study of each topic with laboratory work, considering, when possible, the organs and tissues of his own body. In studying the mouth cavity, for example, he writes in his note book the answers to the following questions which are found in the Laboratory Manual* used by the classes.

STUDY OF THE MOUTH CAVITY.

Take a position with your back toward a strong light, and study your mouth cavity by means of a hand mirror.

A. Walls of the mouth cavity.

1. Press the forefinger against the upper, lower, and side walls of the mouth; in which of these regions are the walls rigid (bone)? In which regions are they yielding (muscle)?
2. What differences do you note between the outer and inner coverings of the cheek? What are the characteristics of mucous membrane (inner covering)?

* Published by Henry Holt & Co.

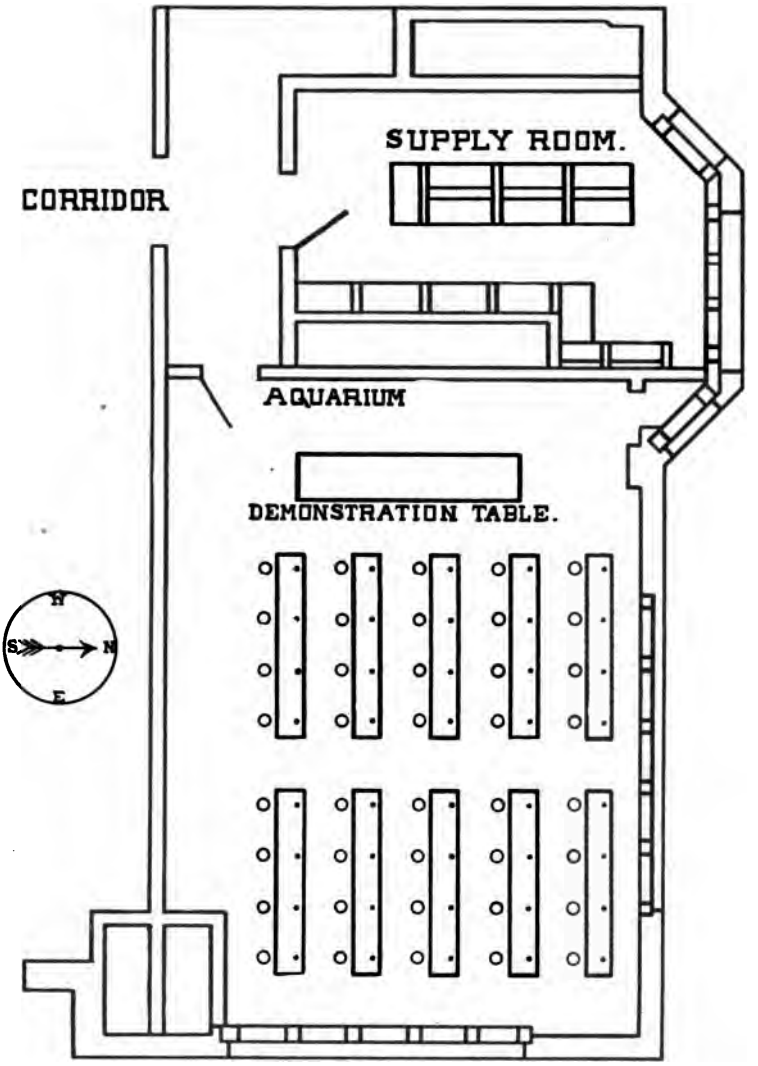


FIG. 8.
PHYSIOLOGICAL LABORATORY.

3. Pull aside with the forefinger one corner of the mouth. Notice the small elevation on the inside of the cheek. Opposite what tooth does it lie? (The duct from one of the salivary glands opens on this elevation.)
4. Press the tongue down with the forefinger. Describe and draw figure of the opening into the throat.
5. If possible, locate and describe the tonsils.

B. The teeth.

1. Close the jaws and open the lips; do the front teeth of the upper jaw cover the ends of the lower teeth, or vice versa?
2. Are the front teeth of the upper jaw larger or smaller than those of the lower jaw?
3. Place a piece of string between the teeth, and describe action of the jaws in biting it off. Describe the movements of the jaws in chewing.
4. Count your teeth and record results in a table like the following:

	RIGHT HALF UPPER JAW.	LEFT HALF UPPER JAW.	RIGHT HALF LOWER JAW.	LEFT HALF LOWER JAW.
INCISORS, - -				
CANINES, - -				
BICUSPIDS, - -				
MOLARS, - -				

C. The tongue.

1. What is the shape of the tongue?
2. Where is the tongue attached?
3. What parts of the walls of the mouth cavity can be touched by the tip of the tongue?
4. What differences do you note between the upper and lower surfaces of the tongue?

D. The use of the lips and tongue in speaking.

1. Pronounce the vowels of the alphabet.
   a. Are the lips closed or open?
   b. Does the tip of the tongue touch the teeth?
   c. Does the tip of the tongue touch the palate?
   d. How is the shape of the mouth cavity altered?
2. What consonants necessitate the closing of the lips? (These consonants are called labials.)
3. What consonants require the tongue to touch the teeth or the palate? (These are called the linguals and palatals.)

Much of the laboratory work is done at home, the written reports being discussed at the following recitation. Text-book lessons in Martin's "Human Body" supplement the facts gained by laboratory work.

In the study of the different organs, continual reference is made to the structure and functions of other animals. After the consideration of the bones and teeth of man and of the animals in the school museum (Fig. 4) the classes are

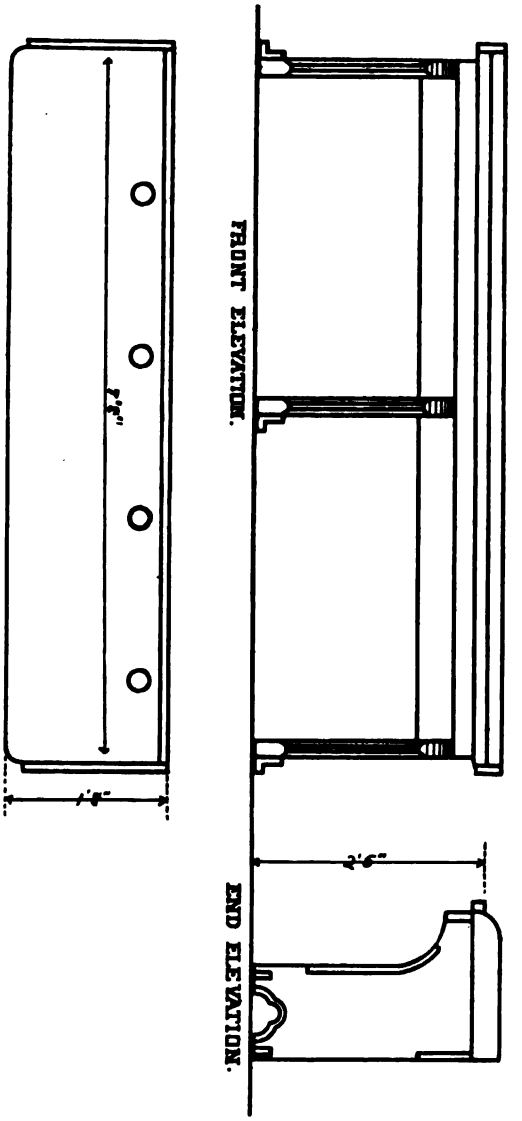


FIG. 9.
LABORATORY TABLE.

taken to the American Museum of Natural History to study other mammalian skeletons. Groups of eight to ten pupils gather about the different specimens (Fig. 3), each pupil answering in his note book the questions given below. The facts gained from this observation are discussed at the museum, and the boys and girls hand in at the next recitation a written account of some of the animals studied.

COMPARATIVE STUDY OF THE MAMMALIAN SKELETON.

A. Spinal column.

1. How many vertebræ are found in the neck (cervical) region?
2. How many vertebræ bear ribs (dorsal vertebræ)?
3. How many vertebræ in the lumbar region?
4. Can you determine how many vertebræ have united to form the sacrum?
5. How many vertebræ in the tail (caudal vertebræ)?
6. In what regions of the spinal column are curves noticeable? How do they differ from the curves in the human skeleton?
7. Are spinous processes specially developed in any region? Can you suggest any reason for this?

B. Ribs and sternum.

8. How many ribs has the animal?
9. How many are attached to the sternum?
10. Is the sternum a single piece of bone? If not, of how many parts does it seem to consist?

C. Anterior appendage.

11. Can you distinguish a shoulder-blade (scapula)?
12. Has the animal a collar-bone (clavicle)?
13. Is the humerus relatively long or short compared with the whole appendage?
14. What is the relative size of radius and ulna?
15. Is it probable that rotation of the radius about the ulna was possible?
16. Is the projection (funny-bone) on radius or ulna?
17. How many wrist bones (carpals) in the anterior appendage?
18. Does the animal walk on the palm of the hand or on the tips of the fingers?
19. How many fingers (or toes) of the anterior appendages does it use?
20. How many bones are there in each finger?
21. Is a thumb distinguishable?
22. What use does the animal make of the anterior appendages?

D. Posterior appendage.

23. Is a knee-cap (patella) distinguishable?
24. What is the relative size of tibia and fibula?
25. How many ankle-bones (tarsals) are found in the posterior appendage?
26. How many toes of the posterior appendage does the animal use?
27. Does the animal seem to be adapted for swift or for slow locomotion? Give reasons for your answer.

E. Teeth.

28. What is the dental formula (number of incisors, canines, grinders) in each half-jaw?
29. Did the animal probably eat animal or vegetable food? Reason for your answer.

Repeated demonstrations from the wall charts (Figs. 1 and 6) by the pupils help to fix in their minds the relative position in the human body of the various organs of digestion, circulation, and excretion which they are studying. Considerable microscopical work is done during the laboratory periods (Fig. 1). Some of the photomicrographs (Fig. 7) are then distributed and the discussion of the pictures serves to make clearer to the students the structures they have been examining.

Perhaps the most practical part of the whole course in physiology is the eight lessons devoted to the study of bacteria. Culture dishes of nutrient gelatine are exposed to the air, others are exposed to the city water, while a certain number of the dishes are kept closed. After several days the dishes are distributed among the pupils, and the colonies of mould and bacteria are studied and figures made. Home work on the growth of bacteria in milk is one of the applications of the subject to everyday life. After experiments in methods of sterilization, the boys and girls are asked the following:

PRACTICAL QUESTIONS IN BACTERIOLOGY.

1. From all your experiments, state (a) what conditions seem to favor the growth of bacteria? (b) what conditions seem to hinder the growth of bacteria?
2. Why should fruits be cooked before canning?
3. Why are foods kept in the refrigerator in summer time?
4. Why should the prohibition against spitting in public places be rigidly enforced?
5. Why should sweeping be done so far as possible without raising a dust?
6. Why should the teeth be brushed often?
7. Why should the refuse be removed from the streets every morning early, especially in summer time?
8. Why should wounds be carefully cleansed and dressed at once?
9. In what ways do bacteria prove to be of benefit to man?
10. In what ways do bacteria prove to be "man's invisible foes"? (Read "The Story of Bacteria," "Dust and Its Dangers," by T. M. Prudden, M. D.).

NOTE.—A course in general biology is to be put into operation next year that will combine much of the work now done in the separate courses in botany, zoölogy, and physiology. Five periods a week are to be devoted to this subject, the main outlines of which are as follows: Introductory experiments in chemistry and physics will give the pupils some first-hand knowledge of chemical elements and compounds, the process of oxidation of, and of the principles of capillary attraction and evaporation. The remainder of the first half-year will

be devoted to the study of botany, emphasis being laid on the *physiological functions* carried on in seeds, seedlings, roots, stems, leaves, flowers, and fruits. In the second half-year the basis of the work is to be the physiology of the human body. Each function will, however, be considered from the comparative standpoint. For example, in studying the subject of respiration the following topics will be considered in addition to those given on page 925:

1. Study of (a) skin of earthworm, (b) gills of fishes, (c) lungs of frogs, reptiles, birds, and mammals.
2. Comparison of respiration in animals living (a) in water, (b) in moist places, (c) in the air.

JAMES E. PEABODY.

The American Microscopical Society.

The twenty-third annual meeting of the society was held in New York City, June 28, 29, 30, 1900. The regular sessions were held in Schermerhorn Hall, at Columbia University, and while the attendance was not large, there was no lack of interest and of good papers. The afternoon session of Thursday was confined to reports of the curator, secretary, and treasurer, and to a brief business session, whereupon the society adjourned to accompany Section F of the American Association for the Advancement of Science on a trip to the New York Zoölogical Garden.

In the evening the society convened at the rooms of the New York Microscopical Society, 64 Madison avenue, to listen to the annual address of the president, Prof. A. M. Bleile, on "The Detection and Recognition of Blood," after which the visitors present were tendered an informal reception by the New York Society.

The morning session of Friday, June 29, was devoted to the reading of papers after a short business meeting. The reading of the tribute to Herbert R. Spencer was the occasion of discussion regarding the Spencer Tolles Fund, which had grown to nearly eight hundred dollars. It was the general opinion that a united effort should be made to bring this fund at once to a point where its income would be available for the encouragement of research, and a committee was appointed to carry out the plan.

The report of the Limnological Commission and papers on various subjects of fresh water biology occupied the afternoon session of Friday, and this programme aroused active interest and discussion of the plan offered.

On Saturday morning the reading of papers was concluded, and the final business session closed the meeting.

The following officers were elected:

President, Prof. C. H. Eigenmann, Bloomington, Ind.

First Vice-President, Chas. M. Vorce, Esq., Cleveland, O.

Second Vice-President, Edward Pennock, Philadelphia, Pa.

Election Members of the Executive Committee: Dr. C. A. Kofoid, Urbana, Ill.; John Aspinwall, New York, N. Y.; Dr. A. G. Field, Des Moines, Iowa.

After the installation of the president and the customary resolutions of thanks, the society adjourned.

The following papers were presented at the meeting in the order given:

"Photographing the Spectra of Colored Fluids," by Dr. Moses C. White, New Haven, Conn.

"A Method for the Measurement and Demonstration of Size in Minute Bodies," by Prof. Henry B. Ward, Lincoln, Neb.

"Herbert Spencer's Work," by Henry R. Howland, Buffalo, N. Y.

"Methods in Embryology," by Prof. S. H. Gage, Ithaca, N. Y.

"A Comparison of the Development of the Larynx in Frogs and Toads," by Prof. S. H. Gage, Ithaca, N. Y.

"On the Distribution of Growths in Surface Water Supplies, and the Method of Collecting Samples for Examination," by Dr. F. S. Hollis, Boston, Mass.

"The Necessity of Maintaining a System of Field Work on Surface Water Supplies," by H. N. Parker, Boston, Mass.

"The Cladocera of Nebraska," by Dr. Chas. Fordyce, University Place, Neb.

"Biological Work at the Mount Prospect Laboratory," by G. C. Whipple, Brooklyn, N Y.

"Some New Forms in the Cave Fauna," by Prof. C. H. Eigenmann, Bloomington, Ind.

"The Modern Conception of the Structure and Classification of the Desmidiaceæ," by Prof. Chas. E. Bessey, Lincoln, Neb.

"Some North American Hydrachnidæ hitherto Undescribed," by Dr. R. H. Wolcott, Lincoln, Neb.

"Limnological Studies at Flathead Lake," by Prof. M. J. Elrod, Missoula, Mont.

"Methods of Producing Color and Tone Effects in Lantern Slides," (illustrated by a series of lantern slides), by John Aspinwall, New York, N. Y.

"Some Notes on Bibliographic Methods in Microscopical Work," by Dr. R. H. Ward, Troy, N. Y.

"A New Ear Fungus of Man, by Dr. Roscoe Pound, Lincoln, Neb.

"Methods in Killing and Staining Protozoa," by Prof. M. J. Elrod, Missoula, Mont.

"Synthetic Alcohol as a Fixing Agent for Tissues," by Dr. T. E. Oertel, Savannah, Ga.

HENRY B. WARD, Secretary.

The Duplex Substage.

To meet the need for a substage attachment which shall be simpler than the Complete Abbe Substage, and still embrace its principal advantages, I have constructed a modification designated the Duplex Substage. Two arms, in place of the usual single one employed in the Screw Substage, are movable up and down upon a metal post rigidly fixed to the stage. The upper arm carries an iris diaphragm which may be used in the plane of the stage or below it; the lower, heavier arm carries the Abbe condenser with an iris diaphragm attached below. In addition to the firmness afforded by the rigidly fixed supporting post, a

metal guide post passes through the arm of each ring, the result of which is to render the substage accessories, when in position, absolutely free from any appreciable lateral movements, and to keep them throughout all vertical movements in the optical axis of the microscope.

The upper arm has a vertical movement sufficient to obtain the best optical results from the iris diaphragm when this is used alone. The lower arm, however, has a vertical movement the upper limit of which brings the condenser into immersion contact with the object slide; from which point it may be rapidly lowered free of the guide post, where it may be swung to the left, completely out of the path of light from the mirror. When in this position it may again be raised, the guide post passing through a second hole in the arm and preventing its accidental displacement.

The adjustment is obtained by the six-strand, quick-acting screw, which the test of years has proven to be a most serviceable means of substage movements. The only opportunity for improvement, that of providing a dust-proof cover for the screw, is now being carried out. EDWARD BAUSCH.

Fresh water planarians deposit their ova in capsules which they attach to water-plants. The ova are naked, and scattered among a mass of yolk-cells larger than themselves. Before treating with any fixing fluid the capsules should be opened with dissecting needles and the contents allowed to flow out into the fluid, after which the ova may be shaken free from the yolk-cells.

LABORATORY PHOTOGRAPHY.

Devoted to methods and apparatus for converting an object into an illustration.

PHOTOGRAPHING WITH A VERTICAL CAMERA.*

The camera and method of photographing described by the author is extremely practical. A good form of camera which can be used either vertically or horizontally is described by Prof. Simon H. Gage in his book, "The Microscope and Microscopical Methods."

Fig. 1.

For photographing plants, fruits, specimens of gross anatomy, objects under alcohol or water, etc., it is quite necessary to work with the camera in a vertical position; as it is almost impossible to arrange the subjects satisfactorily unless they lie naturally upon a horizontal surface. Any sort of construction which provides the vertical camera and a transparent horizontal shelf below it will answer. Of the figures, (1) is sketched from a photograph of the apparatus in use at the Vermont Experiment Station; (2) shows a more elaborate form, admitting of horizontal adjustment, used at the Mt. Pleasant Printery. In both cases the object is simply arranged in the desired position on the shelf, and the camera focused down upon it.

The best work will be possible if a lens of rather short focal length is chosen—one technically known as a "wide-angle" lens; for not only is the range of the camera thus increased, but the sharp focus over a considerable depth, which is absolutely requisite in morphological work, is far more easily obtained.

In focusing, it will be found a decided advantage to select a spot in the object or composition upon the glass shelf a little above its vertical center, and there to affix, temporarily, a white card or paper with fine lines. When this is focused upon, and the lens then "stopped-down," the whole object will be sufficiently sharp. A sky-light is most undesirable for vertical photography, because of the reflection upon the glass platform. Reflections from any source above may be cut off by means of a wire frame or hood, covered with some material, as black velvet.

Fig. 2.

*Botanical Gazette. F. A. Waugh and J. Horace McFarland.

Journal of Applied Microscopy.

L. B. ELLIOTT, EDITOR.

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WITH perhaps few exceptions, those who enter upon a course in higher institutions of learning are more or less perplexed as to just what lines of work will be of greatest value to them in the work they wish to pursue later on. There are, to be sure, definite courses laid out, embracing correlated subjects; yet these are not perfectly satisfactory.

The irresistible advance of scientific study during recent years has brought it to a position where it merits, even demands, attention from any one choosing a course of study, no matter what line of work is the ultimate object in view. An education cannot be considered complete without embracing an amount of training in material sciences sufficient to acquaint its possessor with the work that has been done and enable him to keep in touch with work that is being done by so many of the world's greatest minds.

Young men, especially those who contemplate legal or business careers, are often, in fact no doubt usually, wont to confine themselves to work in the non-material sciences and kindred subjects, to the entire neglect of the material sciences. To pursue such a course, certainly does not result in a well rounded education.

It must not be forgotten that the object of a college course is not, primarily, to cram the mind with facts that pertain directly to the profession chosen; but, on the contrary, it is to train the mind to think, and to meet new conditions. The greater part of any career is spent, not in going over old ground, reviewing old experiences; but in solving new problems, determining relation and significance of new and unexpected circumstances. It is evident, therefore, that the most practical, the most useful education is that which will prepare the mind to cope successfully with these new difficulties.

It cannot be disputed that this is a day of specialists; yet the broader the specialist, the greater his chances for success. Subjects are so interdependent and closely related that to know one well requires more or less familiarity with others; to be a specialist in one, necessitates a general acquaintance with many others.

The puzzling question is: what ones cannot be dispensed with in a most practical and beneficial course of study? Fundamental principles which must be adhered to by every successful business and professional man are: close observation, accuracy, and diligence. Perhaps no work develops these very essentials better, and certainly no work demands them more absolutely, than that along lines of the material sciences. The student of these branches is taught to *see*, and consider the meaning of what he sees; to eliminate every possible chance for error, else his results are incorrect; to keep everlastingly at it, if he would keep pace with his generation. Work of such merit is surely worthy of a due portion of time spent in any course of study.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to
Charles J. Chamberlain, University of Chicago,
Chicago, Ill.

REVIEWS.

Seward, A. C., and Gowan, Miss J. The Maidenhair Tree (Ginkgo biloba, L.). Ann. Bot. 14: 119–154, pl. 8–10, 1900.

This account presents, in a convenient and interesting form, a large amount of information in regard to the external features and internal structure of this peculiar tree. The taxonomic position of the genus itself and the geological history of the Ginkgoaceæ are also discussed.

Those who know Ginkgo only as a somewhat rare tree in our American parks, may be surprised to learn that it sometimes attains a height of nearly one hundred feet, with a diameter of about nine feet. The flowers are diœcious. In the staminate flower a central axis bears loosely disposed stamens. The filament is terminated by a scale and from two to four pollen sacs. Two large ciliated spermatozoids are formed in the pollen tube just before fertilisation. The stem which bears the ovules is called a peduncle, and the collar is regarded as a reduced carpellary leaf. The nucellus is covered by a single integument, the outer portion of which becomes fleshy and the inner woody. Abnormal flowers have influenced the authors in assigning these homologies. In some of these flowers the ovules were borne on the edges of the leaf lamina, while in others the leaf blade was almost transformed into ovules. Fertilization may occur either before or after the ovules have fallen from the tree. The embryo has two hypogeal cotyledons.

The geological record shows that Ginkgo and its allied forms existed in the Mesozoic and Tertiary periods in almost all parts of the world. In northern latitudes, Ginkgo itself was abundant in the Jurassic, Cretaceous and Tertiary.

In its ovules and seeds and in the occurrence of spermatozoids, Ginkgo resembles the Cycads; it also possesses characters suggestive of the ferns. At present it is not included in the Coniferæ, but has been put in a separate division of the Gymnosperms, the Ginkgoaceæ, coördinate with Cycads, Conifers, and Gnetums.

There is a very complete bibliography of over one hundred and fifty papers.

C. J. C.

Campbell, D. H. Studies on the Araceæ. Ann. of Bot., 14; 1–25, pl. 1–3, 1900.

The material for this paper, collected from Alaska, Jamaica, and Kew, at best not easily accessible for stages, yields stubbornly to histological methods so that the early collections, especially, were unprofitable, and the whole series is very incomplete, as the Aroids are mucilaginous and require treatment with non-aqueous killing and fixing agents. The forms studied are *Dieffenbachia*, *Aglaonema*, *Anthurium*, *Philodendron*, and *Lysichiton* (various species), and in spite of difficulties, preparations are sufficiently abundant to show the following facts:

1. There is a one-celled archesporium in *Dieffenbachia*. 2. Ovules are axillary in *Dieffenbachia*, *Aglaonema* and possibly others. 3. The nucellus in all cases is comparatively small. 4. The endosperm early forms a tissue filling the sac close about the embryo, which consequently fails to develop a suspensor. 5. Antipodal cells are numerous (a dozen or more) in *Aglaonema* and *Lysichiton*. 6. Early divisions of the embryo may be (a) filamentous, or (b) of the quadrant type like the fern embryo, but adult organs are not traceable to these primary divisions. 7. The cotyledon is large. 8. The root is lateral in *Lysichiton*, terminal in *Anthurium*.

The paper suggests the following points for study: (a) *Aglaonema* for its large nuclei, which may be of advantage in cytological work. (b) The possible pollination of *Anthurium* by ants. (c) The embryo-sac in all stages and in all species except *Dieffenbachia*, and, (d) the young embryo in all, the old embryo in several species.

The resemblances of the solid endosperm to that of *Isoetes*, and *Selaginella*, of the root to that of *Isoetes*, and of the embryo—as regards suspensor—to that of Grasses, of *Sparganium* and of *Isoetes*, all give hints of relationships; hints which should lead to the further study of the Aroids which the author has undertaken.

JNO. E. WEBB.

Chicago.

Davis, B. M. The fertilization of Albugo candida. Bot. Gaz., **29**: 297–310, pl. 22, 1900.

The recent investigations of Stevens on *Albugo bliti* have furnished such a reliable account of oögenesis, spermatogenesis, and fertilization in this species, that it seems very desirable to re-examine the very divergent history of *Albugo candida* as given by Wager and also by Berlese. In *Albugo bliti*, Dr. Stevens found a multinucleate oösphere, and found further that the numerous nuclei discharged from the antheridium fuse in pairs with the nuclei of the oösphere. According to Wager and Berlese the oösphere of *Albugo candida* contains only one nucleus, which fuses with a single nucleus from the antheridium. Davis confirms the work of Wager and Berlese, and adds some cytological detail and some theoretical considerations.

A papilla from the oögonium works its way through the cellulose wall of the antheridium after communication is established; a single nucleus passes from the antheridium into the oösphere and conjugates with the single nucleus of the latter.

The cœnocentrum is larger than in *A. bliti*, and is beautifully differentiated. The cœnocentrum does not seem to be a permanent organ, but it makes its appearance early in the differentiation of the oösphere, arising as an accumulation of protoplasm and disappearing after fertilization.

Although the nuclei are very small, a few points were determined; division stages are numerous, the spindle is entirely intranuclear, the chromosomes are granular, and, while no exact count was made, Wager's estimate that there are twelve or sixteen is probably correct. Centrosomes were not established with certainty. There is no evidence that the mitoses are reducing divisions.

C. J. C.

Longo, B. Osservazioni sulle Calycanthaceæ. Annuario d. Reale Istituto botanico di Roma, **9**: 1–6, pl. 1, 1899.

The purpose here is the study of the morphology of pollen grain and embryo-sac, and the addition of details determining the relationships in the Calycanthaceæ. Well known histological methods were used.

Observations show that floral development is acropetal with parts wholly free (contrary to van Tieghem), and on an axillary receptacle. The tapetum, be its origin what it may, plays an exclusively physiological rôle, that of nourishing the pollen-mother-cells; its nuclei divide repeatedly, but with such a limited cell growth that each element finally contains several nuclei with one or more nucleoli in each. The pollen-mother-cell at the beginning of division has a nucleus with a nucleolus, and a linin network with chromatin granules; all very sensitive to staining reactions during time of growth. In some preparations the linin network was coiled about the nucleolus, not naturally, however, as some writers maintain, but in response to the action of the reagents; subsequently there is fragmentation of the nucleolus, a breaking down of the membrane and the formation of an equatorial plate from without inwards. Fragments of the nucleolus now appear where later the new nuclear membrane is formed; results are only negative as to the relation of these fragments to the new nucleoli. The pollen grain consists of a vegetative and a generative cell. The nucleus and nucleolus of the vegetative cell are large; the small generative nucleus sometimes contains a nucleolus. The mature pollen grain is yellow and starchy; the intine coat protrudes in two crescent-shaped sacs through slits in the extine. Two potential macrospores are formed, but one soon gains the advantage and the other is atrophied. Two embryo-sacs may be started but only one ever reaches maturity.

These facts lead to the following conclusions: 1. Care must be taken not to draw erroneous conclusions from so-called cyanophilous and erythrophilous reactions. 2. Abnormal karyokinesis in tapetum at the tetrad stage of the pollen-mother-cells shows that tapetum loses karyokinetic power with age. 3. It is impossible to determine the relation of fragments of nucleoli to either the new nuclear membrane or the new nucleoli. 4. The embryo-sac regularly develops from one of several potential megaspores, though but one sac ever reaches maturity. 5. This condition has been observed occasionally elsewhere, but is constant in the Calycanthaceæ and the Rosaceæ. 6. The Calycanthaceæ, as Baillon surmised (1869), should be closely allied to the Rosaceæ in any scheme of classification. JNO. E. WEBB.

Chicago.

NORMAL AND PATHOLOGICAL HISTOLOGY.

RICHARD M. PEARCE, M. D.

Harvard Medical School, Boston, Mass., to whom all books and papers on these subjects should be sent for review.

Tatiana Waschkewitsch. On Areas of Large Cells in the Lymph Nodules of the Spleen in Diphtheria and other Affections. Virchow's Archives, **159**: 137, 1900.

Bizzozero called attention to the occurrence of areas of large epithelioid cells in the lymph nodules of the spleen, intestine, and mesenteric lymph nodes in cases of diphtheria, as early as 1876; but his observations have been generally overlooked. He described the cells as round, oval, or polyhedral in shape, sometimes as much as 30 mikra in diameter, and as containing each an oval, pale nucleus, in which was a distinct nucleolus. In the protoplasm he found, in addition to numerous albuminous granules, two to ten small bodies, a few of the size of the nuclei of lymphoid cells, but many smaller. They were glistening, homogeneous, and stained with carmine; he considered them to be the nuclei and nuclear fragments of lymphoid cells which had been taken up and destroyed by the large cells. In the centers of areas of cells he found only nuclear detritus. This description gives the essential facts about these areas of large cells: improved technique has added but little. They have been described more recently by Barbacci and others, and are mentioned briefly in the text-books of Ziegler and Ribbert.

Waschkewitsch examined the spleens of 200 cases, twenty-four of which were diphtheria, and concludes that Bizzozero described the latter stages of the process. The following is a brief summary of the changes as described by the writer:

In the early stages the cells have a decidedly epithelioid character; they are large, and round or polyhedral; they are more or less spherical, not flattened. They are separated from each other by clefts in which no evidences of cell processes can be found. The protoplasm of the cells is fairly granular or homogeneous; the nucleus is vesicular, stains lightly, is oval in shape, and measures three to five times the diameter of a lymphoid cell. Each nucleus contains a distinct nucleolus. The cells usually contain but one nucleus, rarely two.

The cells frequently contain light yellowish red pigment granules which give the iron reaction; evidently the pigment is derived from hæmoglobin.

Between these large epithelioid cells there occur lymphoid cells, and rarely cells with long, narrow, vesicular nuclei, resembling the nuclei of the normal reticulum.

The areas of epithelioid cells described above undergo degenerative changes. The nuclei are most affected; the chromatin granules and the nucleolus collect on the inside of the nuclear membrane, leaving the outer colorless. The nucleus loses its oval shape and becomes folded; it is kidney shaped, or in marked degrees is irregularly jagged; the nuclear membrane is crumpled.

The protoplasm of the cells also shows degenerative changes; vacuoles appear, and the cells may swell so much as to measure 100 mikra in diameter. The most important change is that the cells fuse together so that they form a coarse network.

In regard to the origin of these cells, Ribbert and Ziegler regard them as cells of the reticulum, while Bizzozero and others do not. The writer believes that they are leucocytes which have wandered in. These areas were found in twenty-one out of twenty-four cases of diphtheria, and in eleven other cases, principally meningitis, peritonitis, and other acute infectious processes. They occurred chiefly in children. R. M. P.

Schüller. A Contribution to our Knowledge of the Etiology of Tumors. Centralblatt f. Bakteriologie, 27: 511, 1900.

The article is preliminary to a more detailed illustrated report to be published later.

The author within the last few months has examined numerous carcinomata and sarcomata taken from various parts of the body, and claims to have demonstrated, in every case, an organism which he believes to be concerned in the etiology of tumors. These organisms in culture he describes as round or oval vesicular bodies, when fully developed three or more times the size of a red blood corpuscle. They consist of a thick, refractive capsule with dark brown contents. The capsule has a radiating, striated appearance, which the writer believes is due to small openings or "pores." The organism in culture varies in size, the smaller being the younger forms. It may occur singly or in groups or heaps. In places the contents can be seen escaping from the capsule, and clumps of empty capsules are frequently found. In living, hanging-drop preparations, flagella-like processes are distinctly recognized. In dead preparations these are withdrawn. The organism is never motile. All these forms can be demonstrated in fresh tissue. Stained specimens are of little value. A small bit of tissue is teased on a slide in absolute alcohol, and cleared with lavender oil. The organisms are frequently found in masses. Sometimes they occur between the cells, sometimes within the cells, often distending them greatly.

Cultures are made from rapidly growing portions of the tumor and never from degenerated areas. Cultures taken from tumors with superficial ulceration are, as a rule, unsuccessful. Washing the excised tissue in corrosive sublimate has a bad effect. The tumor tissue itself is used as a culture medium, though the author is not satisfied with this method. The tissue is put in a sterile glass vessel, and kept in the dark at a body temperature. In successful cultures, within a few days small pearl gray or yellowish translucent droplets appear, which microscopically are seen to be composed of these micro-organisms.

The writer has made some animal inoculations, but not enough time has yet elapsed to complete these observations.

NOTES ON RECENT MINERALOGICAL LITERATURE.

ALFRED J. MOSES AND LEA MCI. LUQUER.

Books and reprints for review should be sent to Alfred J. Moses, Columbia University, New York, N. Y.

Travers, W. On the Origin of Gases Released by Heating Minerals and Meteorites. Proc. Roy. Soc. **405**: 130. Dec., 1898.

Gases, as H, CO_2, Helium and Argon, exist in the free state in substances, as is proved by the presence of gas and liquid pores, etc., and are released by heating. But in the majority of cases the gases which are released from mineral substances under the influence of heat, are the products of decomposition and reciprocal action between the non-gaseous constituents.

L. McI. L.

Reese, L. Inclusions of Petroleum in Quartz Crystals. Jour. Am. Chem. Soc. **20**: 795.

Crystals of quartz, from Diamond, near Guntersville, Marshall county, Ala., show the petroleum cavities below the faces of the rhombohedron.

I. McI. L.

Prior, G. T. Riebeckite in Trachytic Rocks from Abyssinia. Min. Mag., **12**: 92, 1899.

A new occurrence noted.

L. McI. L.

Prior, G. T. Minerals from Swaziland: Niobates and Titanates of the rare earths, chemically allied to Euxenite and Fergusonite; Cassiterite, Monazite, etc. The "Æschynite" from Hitterö. Min. Mag., **12**: 96, 1896.

The specimens were found in the stanniferous gravels of the Embabaan District, Swaziland, S.Africa, their probable source being the granite-gneiss, the base of the rock series in that district. The Hitterö "æschynite" was proved by subsequent investigation to be like euxenite in composition, but to resemble the æschynite type crystallographically, hence it should receive a new name. The author, however, considers it possible that subsequent finds of better crystals may prove the Swaziland mineral to be the same as the Hitterö mineral.

L. McI. L.

Liversidge, A. On the Crystalline Structure of Nuggets of Gold and Platinum and of Ingots of Gold. Proc. of the Roy. Soc. of New South Wales, p. 189, 1898.

Etching figures, obtained in sections with hydrochloric acid, show well marked internal crystalline structure and prove that the nugget has not been built up from a nucleus by deposition of concentric layers. Gold ingots also show crystalline structure. Nevertheless, the author holds to the "solution vein theory" for the origin of gold, and does not think the gold has been melted.

L. McI. L.

Viola, C. Homogenität und Aetzung. Zeit. f. Kryst., **31**: 97-115, 1899.

A theoretical discussion leading to the following law: "Every substance is in itself asymmetric. All symmetry is produced by symmetrical intergrowth analogous to twinning."

A. J. M.

Goldschmidt, V. Ueber Krystallssysteme, deren Definition und Erkennung. Zeit. f. Kryst. 31: 135-159.

In view of the tendency to abandon the six systems as fundamental divisions of crystals, Dr. Goldschmidt proposes new definitions by which they may be retained, as follows:

Based on the symmetry of the elements—"A crystal system is composed of all crystals of equal symmetry of elements."

Based on the number of variable elements—"A crystal system is composed of all crystals with an equal number of variable elements."

The term "elements" is understood to comprehend not only the geometric elements which determine the position of faces, but also physical and genetic constants.

In the discussion, the polar elements p_0, q_0, r_0, λ, μ, ν, in which p_0, q_0, r_0 are the units of force in the directions, λ, μ, ν, are called units of intensity. Of these in the six systems there are variable: Isometric, 1; Hexagonal and Tetragonal, 2; Orthorhombic, 3; Monoclinic, 4; Triclinic, 6. But as it is not yet possible to compare the intensity with which particles of different substances are drawn together, although undoubtedly there is a difference in the attraction normal to a cube-face, say in salt and in the diamond, these variables practically diminish by one, and become respectively 0, 1, 2, 3, 5. If from any point (M) we construct lines at angles λ, μ, ν, extending in each direction distances p_0, q_0, and $r_0=1$, these angles and lengths being determined by measurement and calculation, then the parallelopipidon with edges parallel and equal to these lines is the *polar form.*

The following table shows the elements and symmetry of the polar forms in the different systems, and of their gnomonic projection:

SYSTEM.	ELEMENTS.						VARIABLE ELEMENTS	SYMMETRY.		
	p_0	q_0	r_0	λ	μ	ν		PLANES IN FORM	LINES IN PROJECTION	POINTS IN PROJECTION
Isometric .	1	1	1	90°	90	90	0	9	8	1
Hexagonal .	p_0	p_0	1	90	90	60	1	7	6	1
Tetragonal .	p_0	p_0	1	90	90	90	1	5	4	1
Orthorhombic.	p_0	q_0	1	90	90	90	2	3	2	1
Monoclinic .	p_0	q_0	1	90	μ	90	3	1	{1* 0}	{0 1}
Triclinic .	p_0	q_0	1	λ	μ	ν	5	0	0	0

So also six optical variables, consisting of the three axes of the optical indecatrix and three angles between these and the rectangular axes, may be considered. These reduce from equality or parallelism to: isometric, 1 variable; hexagonal, and tetragonal, 2; orthorhombic, 3; monoclinic, 4; triclinic, 6.

Despite the great assistance rendered by etching, electrical behavior, cohesion, etc., the systematic recognition of crystal system will be based on form and optical behavior, and a practical outline would be:

* Former if projected on face normal to prism, latter if projected on symmetry plane.

Measurement on two-circle goniometer.
Construction of gnomonic projection.
Proof of zone-lines by parallelism and common intersections.
Proof of pole distances by equality or rationality.
Choice of elements p_0 q_0 so that simplest symbols result.
Proof of rationality of point distances in terms p_0 q_0.
Determination of character of projection by preceding table, or by:

ORIGIN OF CO-ORDINATES CENTRAL.					ORIGIN CO-ORDINATES ECCENTRIC.		
ANGLES BETWEEN AXES.					ANGLES BETWEEN AXES.		
90°	60°	90°	90°	Neither 90° nor 60°	90°	Neither 90° nor 60°	
$p_0=q_0=1$	$p_0=q_0 \gtrless 1$	$p_0=q_0 \gtrless 1$	$p_0=q_0$	$p_0 \gtrless q_0$	One axis through pole	No axis through pole	
Isometric	Hexagonal	Tetragonal	Orthorhombic	Monoclinic projected on Symmetry plane	Monoclinic projected on plane normal prisms	Triclinic	

But according to choice of projection plane each system of higher symmetry may yield several projections of lower symmetry, and therefore the symmetry of the projection proves only that the crystal belongs to the system corresponding, *or to a higher one.* The lower are shut out. The possibilities are:

POSSIBLE PROJECTIONS.

Actual System.	Isometric.	Hexagonal.	Tetragonal.	Orthorhombic.	Monoclinic.	Triclinic.
Isometric, . . .	3	4	0	6	∞	∞
Hexagonal, . .	0	1	0	6	∞	∞
Tetragonal, . .	0	0	1	4	∞	∞
Orthorhombic, .	0	0	0	3	∞	∞
Monoclinic, . .	0	0	0	0	∞	∞
Triclinic, ...	0	0	0	0	0	∞

Frequently special values of p_0 q_0 indicate the higher symmetry. For example, a hexagonal projection of an isometric crystal may give $p_0=\sqrt{2}$ or $\sqrt{\frac{2}{3}}$; and a rhombic projection in this system may give $p_0=\sqrt{2}$; $q_0=1$. Similarly with hexagonal crystals, a rhombic projection may give $p_0 : q_0=1 : \sqrt{3}$ or $q_0 = \sqrt{3}$; and in tetragonal system a rhombic projection may give $q_0=1$.

In other cases graphic measurements will suggest the higher system.

A. J. M.

Goldschmidt, V. As supplementary to abstracts this journal, vol. 3, p. 770. Zeit. f. Kryst. 17: 192, and 19: 352.

Upon use of two-circle goniometer may be given the following:

Transformation in Monoclinic Systems.—It frequently happens in the monoclinic system that the crystal is more satisfactorily measured with the plane of symmetry as the pole face. To transform the results obtained to those usually recorded (projection on a face normal to prism zone) two methods may be followed:

1°. The simpler method of completing projection and calculating symbols upon the symmetry plane, then transforming these by the rule that $p^1 q^1 r^1 = q\ r\ p$ and $\lambda^1 \mu^1 \nu^1 = \mu\ \nu\ \lambda$, the primes indicating the new symbols and angles. If r^1 is now to be unity, then $p^1 = \frac{q}{p}$ and $q^1 = \frac{1}{p}$, while $\lambda^1 = 90°$ $\mu = 180° - \beta = 90°$.

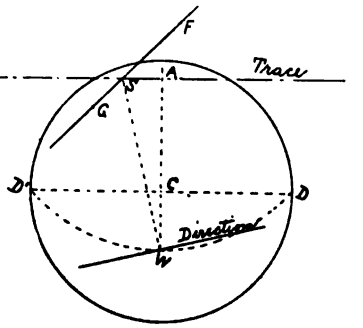
The converse transformation from projection on plane perpendicular to prism to plane of symmetry, requires $p^1 = \frac{1}{q}$, $q^1 = \frac{p}{q}$, $\lambda^1 = 90°$, $\mu^1 = 90°$, $\nu^1 = 180° - \beta$.

2°. The transformation may be effected by calculating new coördinate angles by the formulæ:

$$\varphi^1 = \tan^{-1} (\cos \varphi \tan \rho)$$
$$\rho^1 = 90° - \sin^{-1} (\sin \varphi \sin \rho)$$

Similar transformation for hexagonal system also given.

Simplified Method of Obtaining Clinographic Projection.—The trace of the plane upon which the projection is to be made is assumed at will; A normal, C A and a parallel DD^1 drawn through centre of circle, and the point W found by the arch D^1W from A as centre.



If F and G are two faces in projection, their zone intersects the trace in S, and the desired edge direction is normal to SW.

Faces normal to circle intersect each other in lines normal to trace.

A. J. M.

NEWS AND NOTES.

Action of Salt Solutions upon Eggs.—Sea-urchin eggs, whether fertilized or not, left a short time in sea water containing two per cent. of sodium or magnesium chloride, and then returned to sea water, show clear spots which change in position and number. When these eggs are sectioned and stained the spots prove to be "stars" comparable with those of karyokinesis, and some of the stars have central specks comparable with centrosomes. Unfertilized eggs treated in this way divide into many cells, but the cleavage is not normal and does not lead to the formation of larvæ. The chromosomes are distributed through the eggs, apparently by the action of the stars, and cleavage takes place about the chromosomes as centers. Prof. T. H. Morgan.

ROTIFERA.—Some of the most beautiful metazoan forms are found among the rotifers, and as they may be obtained from stagnant water almost anywhere they may easily be used for life studies under the microscope.

There are many fixed forms, but some of the more common ones are free-swimming and so active that it is difficult to keep them in the field. To quiet them it is recommended to use thick syrup, added drop by drop to the water, or a two per cent. solution of hydrochlorate of cocaine. Warm water also gives good results for some of the larger forms. Congo or neutral red may be used for *intra vitam* staining. For permanent mounts place a watch glass containing a number of rotifers under the dissecting microscope and narcotize them by adding, a few drops at a time, a mixture of two per cent. hydrochlorate of cocaine, three parts, methyl alcohol one part, and water six parts. Watch to see when the cilia are about to stop moving and fix immediately with a drop of Flemming's fluid, or a one-fourth per cent. osmic acid. After half a minute, remove the rotifers with a pipette and wash very thoroughly in distilled water. Mount in two and one-half per cent. solution of formaldehyde and seal.

STREAMING MOVEMENTS OF PROTOPLASM.—Cut off a small piece of the membrane found between the scales of the common onion bulb, mount in water, and examine under a magnification of about four hundred diameters. The room should be warm, and an onion that has started to grow will give more favorable results.

INFUSORIA.—Live Infusoria may be kept quiet for study by adding a few drops of gelatin jelly to the water containing them. A thin jelly made by heating three grams of gelatin with one hundred cc. of water may be kept in stock and warmed when needed for use.

For *intra vitam* staining a number of very weak solutions made up in proportions of 1:10,000 or 1:100,000 may be used. The nucleus may be stained by dahlia or malachite green, and if the two are used together a contrast staining in which the nucleus is green and the protoplasm violet, may be obtained. Infusoria will live for weeks in a solution of anilin black, which serves as a dark background for them. Weak solutions of methylen blue are also useful.

METHODS FOR INJECTING ANNILIDS.—The large sinuses and the intra-epithelial capillaries of leeches may be easily traced after hardening in weak chromic acid. This method is very satisfactory for study by means of sections.

Most annilids must be killed before injecting, and for this purpose a little chloroform or alcohol may be added to the water containing them. Leeches will drop to the bottom of the dish in a few moments, but should be left for a day or two before injecting. Chrome yellow, which may be obtained as a precipitate by mixing solutions of potassium bichromate and acetate of lead, is washed on a filter, partly dried, and then ground and added to an aqueous solution of gelatin, and the mass filtered warm through linen. This makes a good injecting mass for dark tissues. The syringe should be placed in warm water before filling with the gelatine, and immediately after injection the animal should be placed in cold water to stiffen.

INSECTS.

SPIDERS: *Agelena nævia.*—Fresh eggs may be studied while immersed in pure oil, and for the study of external features eggs may be hardened in alcohol and cleared in oil of cloves after removing the shell. To prepare for sectioning heat the eggs in water to 80° C., cool slowly and pass through the alcohols. Corrosive sublimate makes the eggs too brittle. Grenacher's borax-carmin stains well, but the later stages require staining for a long time, and need to be rehardened to prevent maceration. The nucleus lies in the center of the egg surrounded by nearly clear protoplasm. The blastema or peripheral layer of protoplasm contains numerous oil globules. Later, the central nucleus divides and the resultant nuclei with portions of the protoplasm migrate to the surface and enter the blastema, forming the blastoderm.

LUMINOUS EGGS.—The eggs of fireflies (*Lampyridæ* and *Pyrophorus*) are phosphorescent, and the larvæ possess luminous organs during their development. The source of the light varies in position at different stages of development and in different species.

Dorfmeister found that by lowering the temperature to which the pupæ of *Vanessa urticæ* were exposed, he could produce forms transitional to the Lapland varieties. *Vanessa atalanta* kept at 10° to 11° R. at the time of pupation, and kept afterwards at 7½° to 5½°. R. developed variations in coloring.

FLEA'S EGG.—Transparent, and devolopment easily followed, from three to twenty-four eggs laid separately. Hatch on ninth day, larva has no appendages except small antennæ (one pair) and one pair mandibles. In eight days spins cocoon and comes out in nine days.

RELATION BETWEEN THE COLOR OF MOTH LARVÆ AND THEIR FOOD PLANTS.—Poulton experimented upon the larvæ of *Smerinthus ocellatus* by placing them upon different colored food plants, and found that the color of the larvæ varied according to the foliage upon which they lived. He drew the conclusion that the color of these larvæ is determined by hereditary influence, by the color of the leaf on which it lives, and not by the substance of the leaf when eaten, and by individual variation. This is a case of resemblance to environment and not a result of natural selection which has produced a resemblance to all the food plants of the larva. It is due to the absorption and product of pigments rather than modifications of those already formed.

TO STUDY VENATION IN THE WINGS OF INSECTS.—A wing that has never been dried is placed in seventy per cent. alcohol, followed by absolute, for a few days, and then in turpentine for a day or two, when it is plunged into hot water. This converts the turpentine between the layers into vapor, which pushes them apart enough to make their further separation easy.

TO PURIFY AND HARDEN COMMERCIAL PARAFFIN.—Heat in a sand bath with distilled water and a small amount of solid caustic potash. When all is dissolved mix well, and after a short time there will be a precipitate which will settle, and after that the paraffin is poured off, washed with distilled water, and reheated for several hours at a much higher temperature. If the paraffin turns yellow, wash with a warm weak solution of caustic potash.

PHOSPHORESCENT FUNGI.—*Trametis pini*, *Agaricus mellins*, *Xylaria hypoxylon*, *Collybia tuberosa*, and *Micrococcus pflugeri* are phosphorescent. The different species present different spectroscopic characteristics.

TO STAIN SPERMATOGENIS.—Sections fixed in Flemming are fixed to a cover-glass and left for twenty-four hours in strong oxide of copper. Wash repeatedly in water and place in one per cent. aqueous solution of hæmatoxylin for about five minutes, when they will be intensely colored. Wash in a 1/300 solution of nitric acid, which gives a yellow color. The action of the acid is stopped by replacing the slide in copper solution, where the section becomes violet-gray.

MOTION OF PLANTS.—Oscillaria æriegineo-cærulea (found in stagnant water; color blue-green), has been found to be capable of six different kinds of motion: (1) rotation around the axis of a filament or of its segments; (2) a creeping or gliding motion over a solid substratum; (3) free movement of translation in the fluid; (4) rotation or flexion of the filament; (5) sharp tremblings or concussions; (6) radiating arrangement of entangled filaments.

Amœbæ may be caught by lowering a small glass trough or a glass tube to the bottom of an aquarium. After about twenty-four hours the amœbæ will be found in numbers crawling on the inner surface of the glass.

Publications Received for Journal Library.

Index Catalogue of the Library of the Surgeon-General's Office, U. S. Army. Vols. 1, 2, 3, 4, 1896–1899. It is noted in the preface that the Surgeon-General's library in May, 1899, contains 130,708 bound volumes, and 220,839 pamphlets.

New York State Museum, Bull. No. 5. Report of the State Botanist, 1898.

Transactions of the Natural History Society of Glasgow, 1896–97. This is a collection of carefully worked out papers on topics of general scientific interest, and includes some observations on changes brought about by natural agencies acting through a number of years.

Contributions and Shorter Notes from the Zoological Laboratory of the Indiana University, containing illustrated abstracts from papers presented before the Indiana Academy of Sciences for 1899.

Agricultural Bulletins. U. S. Dept. of Agri. Bull. No. 7. The Wilt Disease of Cotton, Watermelon, and Cowpea. 1899. Erwin F. Smith.

University of Tennessee Exp. Sta. Vol. 10, No. 4, 1897. Vol. 11, Nos. 1, 2, 3, 4, 1898.

Maryland Exp. Sta. Twelfth Annual Report.

Contributions to Biology from the Hopkins Seaside Laboratory of the Leland Stanford, Jr., University. X. Scientific Names of Latin and Greek Derivation. Walter Miller, 1897. This paper is an attempt to resolve some of the difficulties of nomenclature encountered by the biologist in compounding words of Latin or Greek origin.

Neurasthenia. The Pathogenesis of Functional Nervous Diseases and their Prophylactic Indication, by Dr. John Punton.

Bolletino della Societa Roma per gli Studi Zoologin. Vol. VIII, Fasc. III, IV, e V, 1899.

Das Mikroskop und seine Anwendung. 8vo., pp. I–IV + 326, 1899. Written by Dr. Hermann Hager, after whose death the book was edited and published by Dr. Carl Mez.

Observations on the Hatching of the Yellow Perch, by S. G. Worth. (Bull. U. S. Fish Commission.)

Oysters and Methods of Oyster Culture with Notes on Clam Culture, by H. F. Moore, Ph.D. (Bull. U. S. Fish Commission.)

Report on the Mackeral Investigations in 1897. The Utility and Methods of Mackeral Propagation, by J. Percy Moore, Ph. D. (Bull. U. S. Fish Commission.)

Several Unusual Cases of Skin Diseases Observed in Indianapolis, by A. W. Brayton, M. D.

The Embryology of the Sea Bass, by Henry V. Wilson, Ph. D. (Bull. U. S. Fish Commission.)

The Life History of the Toad, by S. H. Gage, Ph. D.

The Peripheral Nervous System of the Bony Fishes, by C. J. Herrick, Ph. D. (Bull. U. S. Fish Commission.)

On the Blood-plates of the Human Blood with Notes on the Erythrocytes of Amphiuma and Necturus, by Gustav Eisen, Ph. D.

On the Development of the Cetacea, by John A. Ryder, Ph.D. (Bull. U.S. Fish Commission.)

On the Feasibility of Raising Sponges from the Egg, by H. V. Wilson, Ph. D.

On the Felsitis and Associated Rocks of Mount Read and Vicinity.

Supplementary Note on Linmrite in Tasmania, by W. H. Twelvetrees, F. G. S., and W. F. Petterd, C. M. Z. S.

On Two Species of Larval Dibothria from Yellowstone National Park, by Edward Linton. (Bull. U. S. Fish Commission.)

Journal of Applied Microscopy.

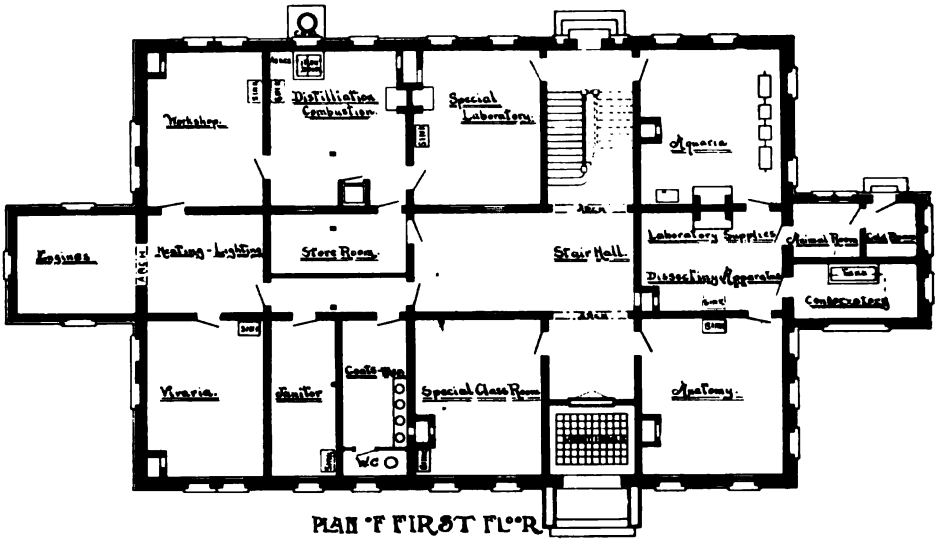
VOLUME III. AUGUST, 1900. NUMBER 8

Biological Laboratory of Western Reserve University.

LABORATORY BUILDING.

The biological laboratory of Western Reserve University, which was occupied in September, 1899,* stands on the campus of Adelbert College, facing west, with ample space on all sides. It is a substantial stone structure in Gothic design, of three stories, with a closed basement for hot-air ducts and pipes. The outside dimensions are 93x63 feet. Small wings projecting from the north and

* This laboratory was dedicated on June 13, 1899, on which occasion an address on *Scientific Laboratories* was delivered by Professor Brooks of Johns Hopkins University. The architect of the building is Mr. C. F. Schweinfurth of Cleveland.

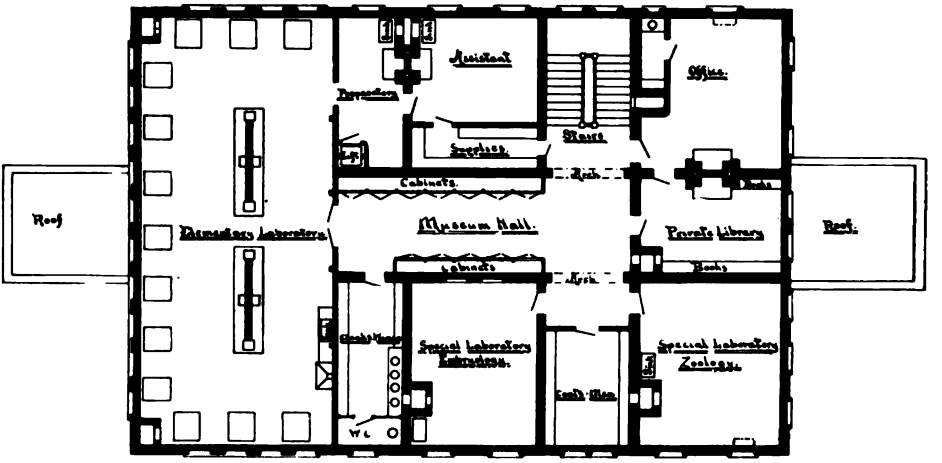


PLAN OF FIRST FLOOR

south ends extend up to the second story. No pains have been spared to provide the best available means of lighting, heating, and ventilation. Gas for combustion purposes, water, and electricity for artificial light are conducted to all working rooms. Heat and ventilation are provided by currents of air heated by steam from a central station in the main building and driven by a steam fan.

In those rooms where the nature of the work, such as section cutting, makes it necessary to avoid strong air currents, direct steam radiation is provided.

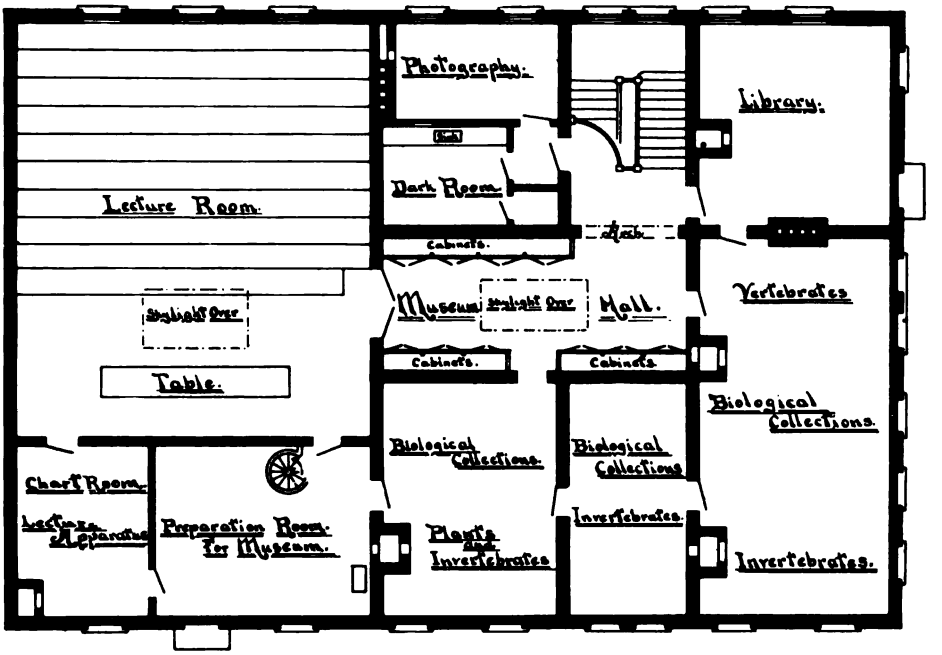
The first story contains suitable rooms for anatomy, botany, aquaria, vivaria, combustion of refuse, and the heating apparatus, also carpenter's workshop, store, coat and toilet rooms, and a janitor's room. The engine and fan are placed in the north wing to avoid noise and vibration in the main structure. A solid partition



PLAN OF SECOND FLOOR.

divides the south wing, which contains on one side a small conservatory for plants; at the back are smaller rooms with entrance from the outside. A large water tank is set in the floor of the conservatory, in which aquatic animals and plants can be reared. This section is so planned that a greenhouse extension of any desired proportions can be easily added. Several rooms of the first story have been designed for vivaria, in which animals may be kept alive and studied. These have good light and ventilation, and cement floors.

The main elementary laboratory, on the second floor, is designed for large classes in elementary biology. An adjoining room connects by lift with combus-



PLAN OF THIRD FLOOR.

tion room below. In the same story are the offices of the instructors, special laboratory rooms for zoölogy and embryology, coat, cloak, and toilet rooms, with preparation and supply rooms to the main laboratories.

The third story is divided into a large lecture room, a photographic laboratory, and a series of museum and preparation rooms.

The northern section of the building has a peaked roof, while a flat crenellated roof covers the southern end. The museum hall of the third floor is lighted by skylight, and the hall below this partly by glass set in the flooring above, in accordance with the plan of placing in these halls the popular collections of natural history, mammals, birds, and fishes, which will be seen by all persons who enter the building.

The type of table adopted for the use of elementary students is similar to the lower part of the ordinary roller-top desk. As a rule, each table has two drawers

LABORATORY TABLE.

with a cupboard at the side, while a few have in addition a long drawer just beneath the top. When two sets of students use these tables, to each person is assigned a drawer which contains ample space for notes and simple apparatus, while the cupboard is used in common, and contains only the microscope, which can be set inside and does not need to be replaced in its box. This table has the following dimensions: height from floor, 29 inches; top, 30 x 42 inches; large drawer beneath top, 25⅛ inches long by 3 deep by 20 broad; two small drawers, each 12 inches long by 3⅝ deep by 24 broad; cupboard, 15¼ inches tall by 12¼ long by 27 broad—or deep (measured breadthwise of table). The small drawers have compartments, and are designed for holding drawing materials and instruments. All are of three-quarter-inch oak stuff in antique finish, excepting top, which has dull paraffined surface.

The design is to give each student a table which affords sufficient working space and offers as many conveniences as possible. Students do better work as a rule when they have their own tables and their own tools. The system of individual tables cannot be carried out, however, in cramped and poorly lighted quarters. Vienna bent-wood chairs with cane seats 18 in. from floor, are used with these desks.

The elementary laboratory has an area of 60 x 27 feet, faces north, and is lighted by eighteen windows of ample size. It affords space for forty individual tables of the pattern described, arranged in two rows facing the windows. Forty persons

ELEMENTARY LABORATORY.

are enough for any laboratory at one time. If classes are larger than this they should be divided into sections, according to my experience. The window area is sufficient to afford good light for use of the microscope even on dull days. The wall tables are all provided with electric incandescent lights, and when a satisfactory standard has been obtained each table will have its own lamp. Farther back from the windows are two stationary tables with gas and water pipes, each with dull black tops, measuring 12 x 4 feet, and standing 31

LECTURE ROOM.

ASSISTANT'S ROOM.

and 35 inches from the floor respectively. These tables are for physiological work and demonstrations, and contain an ample supply of drawers and cupboards. The sinks in this and every laboratory room are of white porcelain and

LECTURE ROOM.

are provided with long goose-neck cocks which effectively prevent spattering.

The small room leading from the main laboratory contains a reference collection of animal and vegetable tissues, material for laboratory study and reagents. This leads to the assistant's room, in which are numerous cases for apparatus and reagents.

Smaller laboratories on this floor, designed for graduate students and classes in embryology and zoölogy, are provided with water bath, incubator, direct and indirect heating. Books of reference and materials are kept in the rooms where the special work to which they relate is carried on.

The lecture room on the third floor has a high vaulted ceiling and is lighted mainly by a large skylight. It contains 156 seats, arranged in ascending series, and provided with folding tablets. The room can be darkened instantaneously

PRIVATE OFFICE.

by means of screens controlling skylight and windows, and worked by vertical cords in one corner near the lecture table. The mechanism governing the screens is simple and self-adjusting. The screen, which consists of a frame covered with black patent leather cloth, is moved in place by pulling a cord and drawn back into its case in a similar manner. The horizontal screen is worked by wires fastened to each end. These pass over stationary pulleys and are continuous around a free pulley in a box at the level of the floor of the lecture-room. The vertical screens are governed in a similar manner, but have free compensating weights, which automatically take up any slack which may occur in the system.

The third floor contains a general reference library-room and photographic rooms, and a series of museum rooms as already described. These are designed for general teaching collections, illustrating the comparative anatomy and development of animals.

F. H. Herrick.
Western Reserve University.

On the Histology of the Amnion.

A former number of the JOURNAL OF APPLIED MICROSCOPY* contains an article by F. B. Nichols entitled, "Notes on the Histology of the Amnion." I have been engaged myself, for several years, in the study of the histogenesis of the human placenta, and during this time have collected quite a large amount of material. About a year and a half ago I came into possession of a full-term placenta, which presented the same anomaly described by Nichols. Like him, I considered such an amnion a very favorable object for silvering. In doing so I made some observations which I considered new, and I therefore demonstrated the silvered tissues before the Chicago Pathologic Society. The bi-annual

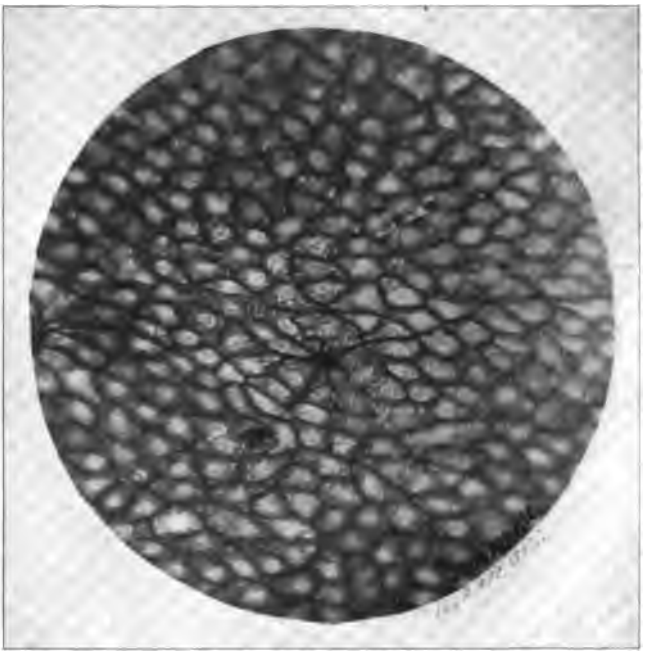


Fig. 1.
Unattached, free amnion silvered.

transactions of this society, now in the hands of the printer, contain the following abstract of the remarks I made when presenting the specimens:

"The microscopic specimens exhibited come from a full-term amnion, which presented the unusual feature of being completely unattached to the chorion, and separated from it by a quantity of chorionic (not amniotic!) fluid. This condition is not often found in man, although it is the normal state of things in many of the mammals, for instance the sheep. I received this amnion and the placental structures at once after they had been delivered together with a healthy child. In order to immediately decide whether this amnion was covered

*Vol II, p. 492.

on both sides with epithelium, it was silvered in the manner used ordinarily for the purpose of demonstrating inter-cellular cement substance, lymph—stomata, etc."

"Epithelium was found to cover the amnion on one side only; the process of silvering, however, demonstrated some interesting features. While with the ordinary methods the amniotic epithelial cells appear more or less as regular columnar cells, the silvering clearly shows that they are very irregularly polygonal. The cell boundaries are fine, irregularly wavy lines. The silvering shows very beautifully the vacuolation of the cell protoplasm, which has been demonstrated before by the ordinary staining method. The silvering also shows that intercellular protoplasmic bridges, claimed to have been demonstrated, do *not* exist. The most interesting feature shown is the following: here and there one can see

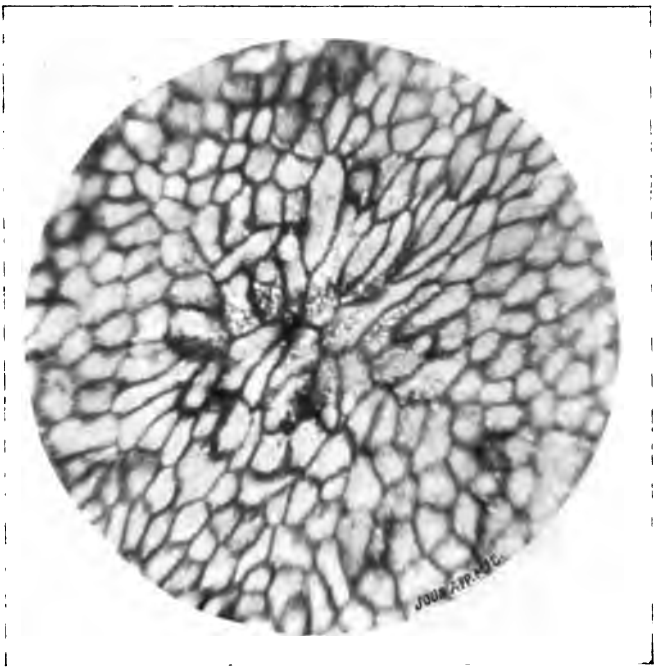


Fig. 2.
The same as No. 1; nuclei stained with hæmatoxylin. The center of the field and the left side of the periphery show lymph-stomata.

very dark spots, around which the epithelial cells are grouped. The picture seen is identical with that of the lymph-stomata of peritoneum and mesentery. *It appears therefore that the amnion is a true serous membrane with lymph channels and lymph-stomata.*"

With reference to *Nichols'* description, I did not at the first examination of the free, unattached amnion, find what he describes as non-nucleated (?) endothelial cells of the outer surface of the amnion. I have again examined my slides and fail to find anything of the kind. MAXIMILIAN HERZOG.

Laboratory of Pathology of the Chicago Policlinic.

Weigert's New Stain for Elastic Fibers.

In May, 1898, Weigert* published a new method for staining elastic fibers in tissue. I have used this new stain very extensively ever since the new formula was first announced, and I cannot recommend it too highly to histologists and pathologists, since it is very simple and very efficient. It excells all other methods of staining for elastic fibers.

Weigert says that the stain may be employed after fixing and hardening in alcohol, formalin, Mueller's and Flemming's fluid, and corrosive sublimate. I find that when the latter has been employed as a fixative, it is necessary to carefully remove by Gramm's iodin solution, all traces of the bichloride of mercury, otherwise the elective stain is less satisfactory.

Fig. 1.
Elastic fibers in a myoma of the skin.

The formula for Weigert's new stain is as follows:

1. Take 2 gms. of fuchsin (the ordinary basic fuchsin used for bacterial stains, not Weigert's acid fuchsin), and 4 gms of resorcin, boil in 200 cc. of water in an evaporating dish.

2. When boiling add 25 cc. of liquor ferri sesquichlorat, stir and keep boiling for two to five minutes.

3. Cool and filter. There remains on the filter a dark precipitate.

4. When all fluid has drained off, dissolve the precipitate on the filter in

*Centralbl. f. d. Allgem. Pathol., 1898.

200 cc. of 94 per cent. alcohol, which is boiled in the evaporating dish first used.

5. When the alcohol has boiled and everything has been dissolved, cool, bring up to 200 cc. again by adding more 94 per cent. alcohol, and finally add 4 cc. of HCl. The stain is at once ready for use.

6. Stain for twenty to sixty minutes.

7. Wash in absolute alcohol (about one minute).

8. Clear in xylol (carbol xylol or anilin oil must not be used).

Preliminary staining of the sections may be done with one of the carmin stains (alum, borax or lithium carmin).

Fig. 2.
Blood vessel in a mass of granulation tissue. The dark ring shows the elastic fibers. The vein is almost completely closed by an endophlebitis.

The elective stain imparts to all elastic fibers a dark black-blue color. I have found the stain particularly useful in studying inflammatory changes of blood vessels.

I reproduce two photomicrographs to show how sharply Weigert's stain brings out the elastic fibers.

MAXIMILIAN HERZOG.
Laboratory of Pathology of the Chicago Policlinic.

Note on Cement for Berkefeld Filters.

It occasionally happens in laboratories where filtration has to be conducted on a large scale, that the porous diatomaceous filters like the Berkefeld, which are largely employed for the purpose, are occasionally broken and have to be discarded or sent to the factory for repairs, which is sometimes disadvantageous. Inasmuch as these filters are very costly, and the formula of the cement used by the makers is a secret one, a method of quick repair which can be used at once is a desideratum. For the want of a better one, I have made use of the follow-

ing formula. Soluble glass is mixed with equal parts of prepared chalk and iron by hydrogen to the consistency of soft putty, and the parts reunited or any flaw in the porous part covered over with it. It is then allowed to dry for a day or two, after which it may be placed in the dry air sterilizer, the temperature of which should not be allowed to go above 150°–160° C. It is then ready for use. Sometimes I vary the proportions, using less iron or substituting some of the powder sandpapered from the filter in place of the chalk, etc. All seem to work fairly well.

The porosities of Pasteur bougies may be repaired by plastering over with the same cement. After the repaired filter has been in use some time and has been repeatedly subjected to the heat of the dry air sterilizer, the filter may be cautiously sterilized without injury by boiling in water. I have some filters now in use which were repaired six months ago with the above cement and are nearly as good as new ones. I offer the above in hopes that something better for the purpose may be offered by the readers of the JOURNAL OF APPLIED MICROSCOPY.

Detroit, Sept. 10, 1900. W. R. HUBBERT.

A Differential Stain for Cell Structures.

Preparations stained in several colors are not always the best to show details of structure. For ordinary class work, however, sections which bring out the various cell organs in distinct colors are very convenient and to a large extent preclude misinterpretations. I have some slides, prepared a number of years ago, which are not only fantastic in color but show details of structure very well. The method by which these slides were prepared was lost and forgotten for some time, but having developed it again I recommend it to those who have beginners at work on the subjects of karyokinesis in plant cells. It will be found best for ordinary root tips and the material must be killed in chromo-acetic acid.

Stain first for two or three hours in anilin-safranin put up according to the fomula given on page 258, Vol. 2, JOURNAL OF APPLIED MICROSCOPY. Next stain for about thirty minutes in an aqueous solution of picro-nigrosin. The picro-nigrosin must be made in the following proportions:

Distilled water, ...	100 cc.
Picric acid, ...	1 grain.
Nigrosin, ...	1 grain.

First dissolve the picric acid completely and then add the nigrosin. After staining, dehydrate and mount in balsam. The stain is permanent, and if properly done the result will be as follows: cell wall well stained and black; cytoplasm of a bluish color; spindle threads, bright green; chromatin network and chromosomes, brick red; nucleoli bright red; thickened connecting fibers of the central, barrel-shaped spindle, dark green and prominent; granules of the cell plate, black.

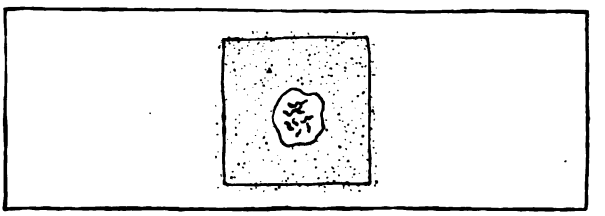
A set of slides stained in this way will not only go far in giving a clear idea of the structures concerned in cell division, but will also show very distinctly the diverse character of the various constituents of the cell.

Botanical Laboratory, Ohio State University. JOHN H. SCHAFFNER.

Mounting in Glycerin.

Although it is often a great convenience to mount small objects in glycerin, the usual method has given very unsatisfactory results in the hands of the writer. Fully fifty per cent. of the glycerin slides put up seven years ago, under the directions of a competent teacher, are now ruined from one cause or another.

The following method will be found satisfactory for making permanent glycerin slides, if one has not the special apparatus usually employed. The objects are taken from water to the pure glycerin by adding the glycerin gradually and permitting the water to evaporate until absolutely pure glycerin alone is left. The



objects are then placed in a small drop of glycerin jelly on the slide and a ring of Canada balsam is placed around the drop, after which the whole is covered with a square or round cover-glass. The glycerin and balsam will not mix, and if the two mounting fluids have spread out properly the slide should appear as shown in the figure. The dotted portion represents the balsam under the cover-glass and the undotted part in the center, the glycerin jelly with the objects. Such slides need not be sealed, but if desired they can be ringed with a proper cementing fluid in the same way as is done when glycerin alone is used.

Botanical Laboratory, Ohio State University. JOHN H. SCHAFFNER.

Blood Dilutions in the Widal Reaction.

The reliability of the Widal test depends upon exact dilutions of blood; these should be definitely known and not guessed at or even approximated.

When a sample of dried blood is sent to the laboratory, it is important to know definitely its quantity. In the method proposed by Johnston the blood is deposited upon paper. In place of paper, Widal suggested a bit of sponge. In a number of laboratories glass slides are used in place of paper. In any case the blood is received as a dried sample in indefinite quantities; it is then mixed with bouillon or physiological salt solution until the proper tint is obtained. But the method of judging of the dilution by means of the color is uncertain, even in the hands of experts.

Methods for obtaining definite minute quantities of blood have at different times been proposed.

McFarland used capillary glass tubes of definite capacity into which the blood was drawn and allowed to dry. The original quantity being known, the tube is crushed in a small mortar and mixed with the requisite quantity of the diluting

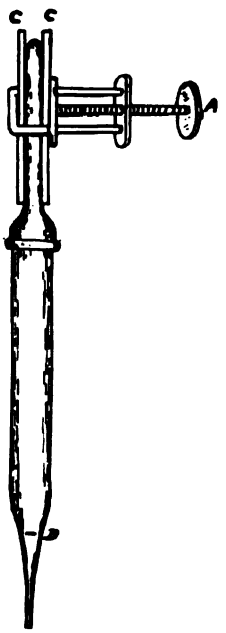
fluid. McFarland says, "While theoretically a method which has much to recommend it, in making large numbers of tests it was found to be cumbersome."

Dinwiddie, in the June number of the JOURNAL OF APPLIED MICROSCOPY, describes the use of a capillary tube of known capacity per millimeter of length. The blood is allowed to enter; the length of the column noted, and the quantity thus determined. The blood is then expelled upon a strip of paper by blowing. Five per cent. is added to the length of the column to compensate for the blood adhering to the wall of the tube. It would appear to one who has used the capillary tube in this way that the percentages of error in withdrawing and delivering small quantities of blood are too great for general application, especially in the hands of the many indifferent persons who send blood to the laboratory.

The application of the wire loop for measuring blood is due to Delphine. A portion of blood is picked up with a loop and deposited upon a glass slide, or, as in certain laboratories, upon a bit of aluminum foil. The objection to this method is that the loopfuls are not deposited in uniform sizes, especially if there be the least trace of grease upon the glass, or even upon the wire.

In the laboratory of the Delaware State Board of Health wire loops are used, but we have found that the deposits of blood made upon slides by physicians were rather variable; enough to make us uncertain that all the blood in a loop had been deposited.

Cabot proposed taking up a quantity of blood with a common medicine dropper, and then expelling one drop into the diluting fluid. This method, of course, was intended only for bed-side diagnosis. We believe that the delivery of a drop of blood from a pipette of a given size is a more accurate method of measuring small quantities than any of the others proposed. But to deliver a single drop of blood free from air from a medicine dropper, whose bulb is held between the thumb and forefinger, it is necessary to draw at least two drops of blood into the pipette to prevent any air being expelled with the last portion of the drop. This means that the patient must receive a rather deep and painful puncture in order to obtain the requisite quantity of blood. Furthermore, the manipulation of the dropper with the fingers alone is unsatisfactory in the withdrawal and delivery of blood from a finger prick. To obviate this, the following simple device has been adopted, which is shown in the figure:



It consists of the ordinary medicine dropper, the bulb of which is enclosed on either side by two narrow strips of metal (c.c.), and both placed in a medium-sized Hoffman clamp. The inward movement of the clamp, by means of the screw (A), compresses the bulb, while a slight turn in the opposite direction dilates it a little and permits a small quantity of blood to enter. The blood is drawn up to a certain mark (B), which represents a full drop. It can then be so slowly and delicately expelled almost to the last portion without the formation of an

air bubble. This is scarcely possible when the fingers alone are used to compress the bulb.

Furthermore, the blood can be easily drawn into the dropper, two or three portions at a time, until the mark is reached, without destroying their continuity. When a small puncture is made, possibly only a part of a drop will at first exude. This can be sucked up, another portion of blood pressed out, and the remaining part of the full drop drawn into the pipette. This is a distinct advantage, as only slight bleeding is necessary and smaller quantities of blood can be handled with certainty and ease.

In expelling the drop of blood from the dropper, the latter is held vertically over a strip of thick filter paper and the full drop allowed to fall upon it. When the blood is dry the paper slip is folded, enclosed in an envelope, and forwarded to the laboratory. The blood spot is then cut out, placed in a small shallow glass capsule, and ten drops of the diluting fluid added from a similar dropper.

The capsule should be provided with a ground glass upper surface upon which a small ground glass plate can be placed so as to form a hermetically tight cover; thus preventing evaporation and concentration of the diluted blood. This cover should be kept in place except when necessary to mix the blood or withdraw a portion of the diluted sample. The writers have found that with the use of this simple device it is an easy matter to obtain and deliver upon paper exact and definite quantities of blood, which can, when received at the laboratory, be diluted in any proportion desired; thus adding greater reliability to the Widal test.

F. D. Chester and A. Robin.

Laboratory of the Delaware State Board of Health, Newark, Delaware.

The Use of Very Dilute Formalin and Vapor.

Formalin has proved useful in so many ways, and is by this time so well known, that it would seem that not much can be said of its uses that has not been tried. Though I have obtained useful results with dilute solutions and have told co-workers from time to time, I do not remember having seen it given for the general reader.

Most of the preservations were made with a one-tenth per cent. solution (of formalin) intended for museum purposes. It works especially well for specimens containing a great deal of water and in which it is desirable to preserve some degree of transparency. Frogs' eggs that were preserved in the gelatinous coatings six years ago are to-day almost like when taken from the water. The gelatinous material has shrunken somewhat, but is quite clear and firm. The eggs were quite hard at first and a few hand sections were cut, showing them not to be very brittle.

Externally, the segmentation can still be nicely seen, but it is not at all probable that this method would preserve the internal structure for microscopical study. After some surer and quick killing agent the dilute formalin might be used for hardening. It is important to use a large bulk of the reagent H at least

ten, and better twenty times, the volume of the specimen. Or, what amounts to the same thing, change the reagent several times.

Preservation with vapor formalin for temporary and permanent uses has some special advantages. Whenever we wish to keep fresh specimens of animal tissues or foods from one day to another for the physiology classes, they are placed in any receptacle, a few drops of formalin poured in, and tightly covered. The chief difficulty is that if anything is left very long it hardens too much. Thus, a raw egg, of which a little had been used, was put away in formalin vapor and after a few weeks was found to be "hard as bone," the white having kept quite transparent. *

This suggested its use for hardening some objects whose transparency it is desirable to retain. The lens of the eye of any animal may be hardened for demonstrating its layered structure in this way and will remain transparent enough to form an image. It eventually becomes as hard as a dried seed and may be broken to show the layers.

L. MURBACH.
Detroit High School.

Sterilizing Instruments During Bacteriological Autopsy Work.

The writer has a beaker or tin of methyl alcohol placed conveniently on or near the autopsy table. A lighted Bunsen burner or alcohol lamp is also close at hand. The blades of knives, scissors, forceps, etc., are dipped into the alcohol and passed quickly near enough to the Bunsen flame to ignite the alcohol. The alcohol burns off instantly, leaving a dry, sterile surface free from any disinfectant. The advantage over direct flaming of the instrument lies in the tendency of the latter process to result in spoiling the temper, or at least the edge, of the instrument. The advantages over the use of disinfectant solutions, as carbolic acid, etc., are:

1st. No disinfectant is introduced into the incised tissue by the knife.

2d. Sterilization is instantaneous and complete, whereas disinfectant solutions require some appreciable time to kill the common pathogenic forms, and a considerable time to kill spores.

3d. If the knife has already been used and resterilization is required, the adherent blood or tissue is readily cleared and rendered sterile, while a disinfectant requires time for penetration. The value of this method in opening the peritoneum, in making incisions into organs, and in all other cases where it is desired to preserve the knife from infecting the cavity or tissue which it opens, has been shown in practice. Experimentally, also, it has been found that anemax spores, smeared upon a knife blade, refused to develop when transferred to media, after the knife blade had been flamed once in alcohol as described above.

This method or any other for opening up cavities or tissues for bacteriological purposes ought of course to be preceded by the burning of the outer surface of the cavity wall or tissue by a hot metal spatula over an area sufficiently large to permit the whole of the required incision to be made within its boundaries.

The writer is not aware of the previous publication of this method, but since it relates to a very minor point in technique, it may easily have escaped his notice.

HIBBERT WINSLOW HILL, M. D.
Director Bacteriological Laboratory, Boston Health Department.

* The uniform hardening of the egg throughout shows well the penetrating power of vapor formalin and its usefulness as a fumigating agent.

MICRO-CHEMICAL ANALYSIS.

VI.

MANIPULATION OF APPARATUS—Continued.

5.—DETERMINATION OF CRYSTAL ANGLES, OPTICAL PROPERTIES, ETC.

It has been already stated that micro-chemical tests depend upon the fact that the addition of certain reagents to the substance to be tested produces, under proper conditions, as to concentration, acidity, temperature, etc., minute crystals of definite form and usually of a quite uniform size. It follows, therefore, that the worker is obliged to note the presence or absence of crystals of a certain geometrical form. Suppose, for example, potassium is to be tested for in a simple salt. Platinum chloride can be added. Well formed yellow octahedra are produced. The conclusion is that potassium (or ammonium) is present; the size of the crystals indicating that it cannot be rubidium, cæsium, or thallium. A pure potassium salt having been previously tested in the same manner, we recognize at once that the test obtained with the unknown resembles exactly that gotten with the known substance.

Ability, then, to recognize similarities and differences is the first and main requisite to successful work. If this be true, it is evident that merely an elementary knowledge of crystallography is essential to the successful performance of analyses by micro-chemical methods.

Although the study of the optical properties of crystals, leading to a determination of their crystallographic systems, etc., is a subject to be attempted only by those thoroughly skilled by training and experience, there are, nevertheless, a few simple tests which even the beginner can attempt, and which will, under proper precautions, give much aid in the unraveling of difficult problems. One must, however, always bear in mind that results of the most puzzling character are frequently obtained, and that too much reliance must never be placed upon optical tests.

First among these, because the most simple, is the determination of plane angles. This is of course not properly an optical test. Great accuracy in measurements is unnecessary, since the object is merely to ascertain whether the crystal under examination is, or is not, a certain compound, and aims in no way at a crystallographic study. In ordinary inorganic analyses, the measurement of crystal angles is seldom, if ever, resorted to; but in mixtures of organic substances and mixtures of organic and inorganic compounds, important information is to be obtained.

When attempting angular measurements, the beginner should be careful to select only thin, well formed crystals with perfect edges—using a low power. Bring the crystal to the center of the field under the cross-hairs. Revolve the stage to learn whether it is properly centered. If out of center, adjust by means of the centering screws. *Perfect centering* of the stage is seldom possible with the low priced instruments usually employed in micro-chemical work. Provid-

ing the centering is good for 180°, satisfactory results can be obtained. The crystal is brought to such a position that one edge of the angle to be measured coincides with one of the cross-hairs of the eyepiece (see Fig. 20). When the cross-hairs are coarse and black, better results will be obtained by placing the edge of the crystal parallel to the cross-hair instead of trying to make it coincide. Take the reading on the circumference of the stage; rotate the latter till the other bounding edge of the angle coincides with, or is exactly parallel to, the same cross-hair (Fig. 20). Read the stage again; the difference in the readings gives the angle sought (x).

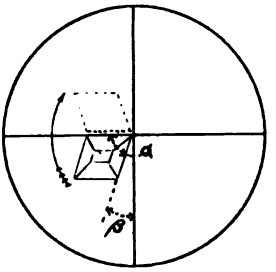


Fig. 20.

If it is known that the cross-hairs in the eyepiece are exactly at right angles (which can be ascertained by experiment) a slightly quicker method consists in measuring the complement of the angle (β in Fig. 20), and deducting it from 90°. Or, if the angle be obtuse, measure the amount that is greater than 90°. This method does not necessitate as careful centering of the stage, and can, therefore, be used with high powers with sufficient accuracy for analytical work. It is essential in all measurements of crystal angles that the instrument be most carefully focussed upon an edge, and that care be taken to avoid error due to the projection of an image of an edge through the crystal. In the case of very transparent crystals it is sometimes difficult to tell which is the proper line (edge) to employ, unless the crystal is thin.

BEHAVIOR OF CRYSTALS WITH POLARIZED LIGHT.

The examination of test drops on the stage between crossed Nicols affords us most valuable information, and is constantly used in the progress of an analysis. Since the beginner first tries the comportment (between crossed Nicols) of known substances treated with various reagents, only an elementary knowledge of the various phenomena which can occur is essential. It is undoubtedly possible to perform successful micro-chemical analyses without having recourse to polarized light, yet the use of this accessory is such a valuable aid, that every student should examine each and every preparation between crossed Nicols. He will thus soon learn more than could be told him in pages of writing. All interested in micro-chemical work unfamiliar with this division of crystallography are urged to consult the standard text-books devoted to the subject.

For the beginner a few general statements and directions can be given which will be useful in analytical work.

In the following directions, reference is made to the microscope described by the author in No. 1 of the present series of articles. In addition to the apparatus there described, the instrument is now supplied with condensing lenses fitting above the polarizing Nicol, to furnish strongly converging polarized light; and with selenite plates, red and white, of the first order. These plates are unmounted and can be used either above the polarizer or above the eyepiece.

When a crystal is placed on the stage of a microscope near the center

of a field between crossed Nicols, and the stage turned, the crystal will behave in one of two ways. 1. It will remain dark throughout a complete revolution of the stage (see diagram A, Fig. 21), that is: there is no change in its appearance in the dark field. 2. As the stage is turned the crystal will

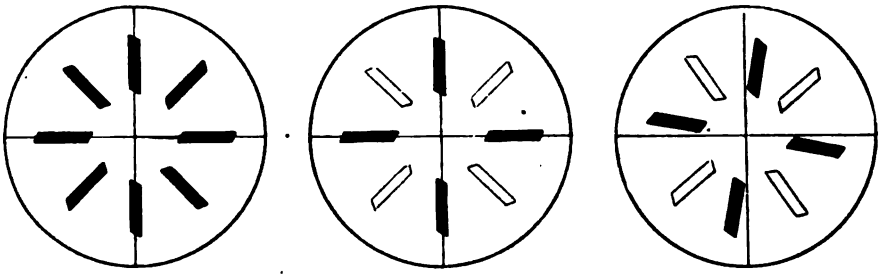


Fig. 21.

alternately become bright or colored, and alternately disappear (extinguish). In this case two possibilities arise. Either the crystal disappears (extinguishes) when its axes coincide with or are parallel to the cross-hairs, and is brightest midway between (see diagram B, Fig. 21), or the position of extinction is not on the cross-hairs, but lies a little to one side (is oblique to) the cross-hairs (see diagram C, Fig. 21). In the former case we speak of the crystal as having *parallel* extinction, and in the latter as having *oblique* extinction.

These phenomena give evidence (not proof) as to the crystallographic system to which the substance belongs.

The different crystal systems behave normally as follows:

Isometric.—Crystals remain *dark* in *all* positions in which they may be placed, and throughout a *complete* revolution of the stage. (Diagram A, Fig. 21).

Tetragonal.—Parallel extinction in *two* positions of the crystal (B, Fig. 21), and in the *third direction no action* (A).

Orthorhombic.—Parallel extinction (B) in *all* directions through the crystal.

Monoclinic.—Parallel extinction in *two* directions and *oblique* extinction (diagram C, Fig. 21) *in the third.*

Triclinic.—*Oblique* extinction in *all three* directions.

Hexagonal.—In *one* direction has *no action* and so remains dark throughout a complete revolution of the stage. In *other directions* exhibits *parallel* extinction. (Compare with tetragonal.)

It is evident that the observation of a single crystal just as it lies in the field of the microscope gives insufficient information to lead to a decision as to its system. Moreover, it is seldom indeed that in the course of analytical work a crystal is obtained which is of sufficient size, or proper shape, to permit its being turned over so as to allow an examination by polarized light in different directions.

The problem is, therefore, not so simple as it would appear at first sight. Besides, it will be seen that, when lying in certain positions, examination with plane polarized light will not yield definite information. Recourse must then be had to *strongly converging* polarized light as given below.

In the vast majority of cases, the test drop will yield a field in which crystals can be found lying on different faces. Thus a careful search will generally enable the worker to pick out, here a crystal in which the light is transmitted in the direction of one axis, there another crystal in which it is sent through in the direction of another axis. It is of the utmost importance that several crystals be examined; and a decision must never be formed from the examination of one crystal only.

In the case of crystals exhibiting oblique extinction,—i. e., those belonging to the monoclinic and triclinic systems,—the amount of obliquity between the position of extinction and the cross-hairs can be determined, and is characteristic for certain species. It thus serves as a valuable means of ascertaining whether the compound being examined is in reality the substance sought. This obliquity is measured in degrees, is known as the *extinction angle*, and can be defined as "the angle between the edge of a crystal and an axis (or direction) of elasticity." In practice the angle is chosen which is formed by the *longest edge* of a crystal of normal growth and the *nearest* axis of elasticity. As indicated in the diagram (Fig. 22, A), the angle *agc*, formed by the edge *ab*, and the nearest axis of elasticity (or vibration) *cd*, is the extinction angle. In crystals exhibiting parallel extinction, the extinction angle is 0° (see Fig. 22, B).

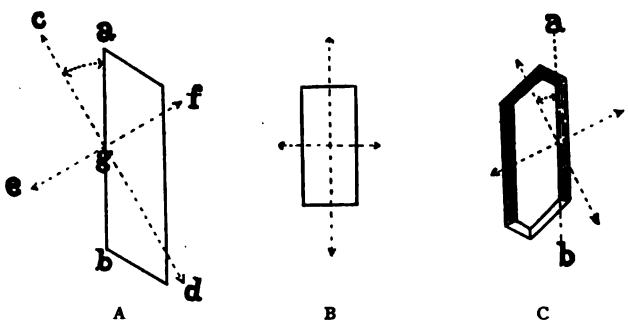


Fig. 22.

Since the position of maximum brightness and darkness is somewhat difficult for the beginner to determine, the following method is suggested for obtaining the extinction angle. The crystal to be tested is brought to the center of the field so that an edge corresponding to *ab* (Fig. 22) is very close and *exactly* parallel to one of the cross-hairs. See that the polarizing Nicol is properly in place and at zero. Focus sharply. Lay the selenite disk (red of the first order) on top of the eye-lens of the eyepiece in such a position that a line joining the two black dots situated opposite each other on the selenite will form an angle of 45° with the cross-hairs. Set the analyzer in place with the prism at zero. On looking through the instrument a red field should be seen in which the crystal appears of a different color. The reading of the stage is taken and the stage then turned until the crystal acquires the same color as the field, namely, red of the first order. This new position marks the direction of elasticity (vibration). A reading of the stage is again made. The difference in the two positions will give the extinction angle. Or, since both the polarizer

and the analyzer are graduated, either one of these can be turned instead of the stage, and the reading made when both the field and the crystal have the same color. It is well to bear in mind when employing this latter method that, the graduated circles being smaller, concordant accurate results are more difficult to obtain. It is wise to check the result of one method by the other.

When dealing with thick crystals having beveled edges, it will be found most convenient to focus upon the upper edge as shown in the diagram (*ab*, Fig. 22, C).

Rarely, the analyst is called upon to make further optical tests on a preparation than those above described. If he wishes more information as to the probable crystal system to which the substance under examination belongs, he must have at hand the means for obtaining strongly converging polarized light. With the microscope referred to above, this is accomplished by removing the cap protecting the polarizing prism, and screwing on, in its place, a cap provided with two lenses so arranged as to converge the light to a point. The crystal to be examined is brought under the cross-hairs and focussed, using an objective of *high* power. The *eyepiece is then removed*, the analyzer placed in position, and the Nicols crossed. If the experiment is properly conducted, the crystal in the proper position and of the proper thickness, the observer on looking into the instrument will note different phenomena according as the crystal is uni-axial or bi-axial. *Amorphous substances* and those belonging to the *isometric* system normally *give no action.* Crystals of the *tetragonal* and *hexagonal* systems give a *symmetrical black cross* on *concentric* rainbow-colored *circles.* While in the case of crystals belonging to the *orthorhombic*, *monoclinic*, and *triclinic* systems (*bi-axial* crystals), the dark cross is *not symmetrical* and lies upon *two* or more *sets* of *elliptical* rings.

Since uni-axial crystals under certain conditions may yield one of these so-called *interference figures* in which the circles may appear to be ellipses, it is generally advisable to *turn* the analyzing Nicol and note well the changes produced, particularly in the black cross. With perpendicular sections, there is *now* obtained in the case of the tetragonal and hexagonal systems, a *light* cross with the circles still concentric, but with their spectrum colors *reversed.* On the other hand, in bi-axial crystals under like conditions, the black cross *opens out* into *two hyperbolas*, cutting the sets of ellipses at opposite ends.

The determination of the positive or negative character of crystals is so seldom called for in ordinary work, that the methods to be employed for this purpose, when working with the "chemical" microscope, need not be described.

Such, in brief, are a few of the optical characters of crystals which can profitably be employed from time to time as an aid to chemical reactions for the detection of the various elements and their compounds.

The worker in micro-chemical analysis is advised, and urged, to depend more upon chemical reagents and properties in drawing his conclusions, than upon the results of any optical tests he may have applied, since he will be far less liable to be led into error.

E. M. CHAMOT.
Cornell University.

Libraries of Microscopical Slides.

Since the earliest times it has been the custom of educated people to have libraries. No line of thought has received more attention in the past few years than the biological sciences. Probably the world has received more physical good from such work than from any other source. What the next generation will bring forth can hardly be imagined. Everyone who owns a microscope is adding a little to the world's stock of knowledge in biology. Not only does such a worker need books, but he should make another kind of a library—a collection of slides. To the teacher in biology this is almost a necessity. To make the slides of greatest use they should be classified in some systematic way. It has been my experience and observation that in many small as well as large colleges and universities, the slides are packed away without any or very little system, and the teacher must depend upon his memory in finding them. This causes very much annoyance and much loss of time. Last fall I classified my slides in a simple way, and it has been of so much value to me that I feel it is important to call the attention of other workers to this, or at least suggest something that will cause them to do the same thing.

The slide box or tray is marked with Roman numerals. The places for the slides are usually marked with the Arabic numbers by the manufacturer of the boxes. On the label of each slide is marked the Roman numeral which indicates the number of the box in which the slide is to be placed and the Arabic number which indicates its position in the box.

All the slides are now catalogued on cards or on sheets of paper. In cataloguing, the name of the specimen on each slide should be given, and following it the Roman and Arabic numbers on that particular slide. The cards should be arranged alphabetically and kept near the slides. Since the slides are used by the different students, they will have to be replaced, and by this method any one can tell in an instant where it belongs. If, for instance, you desire a section of liver, look for same on card. The reference may be XII—24, hence find box XII and the slide will be found at "24."

Moore's Hill College. A. J. Bigney.

A few snails kept in an aquarium will deposit eggs from which the segmentation and early developmental stages of the mollusc may be easily studied. The ova are yellowish and are deposited in patches on the glass or on the smooth under side of leaves in the aquarium. Eggs that are not used for the study of early segmentation stages may be allowed to develop and will show the various stages through which the snail passes in its evolution. Interesting observations may be made upon the snails themselves. The gliding motion and muscular contraction of the foot, the use made of the tentacles, the position of the eyes, the way surface tension is utilized in crossing over the top of the aquarium, etc., will always repay watching.

Journal of Applied Microscopy.

L. B. ELLIOTT, EDITOR.

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The majority of our subscribers dislike to have their files broken in case they fail to remit at the expiration of their paid subscription. We therefore assume that no interruption in the series is desired, unless notice to discontinue is sent.

The American Microscopical Society is at present energetically engaged in a very laudable undertaking in making a special effort to increase the Spencer-Tolles fund to a size where its proceeds can be applied to the purpose for which it was intended; viz., the encouragement of original investigation in the direction of the optical and mechanical improvement of the microscope and microscopical accessories, or in some branch of science in which the microscope is essential.

The following historical reference and request for contributions has been issued by the secretary: "After the death of Charles A. Spencer in 1881 and of Robert B. Tolles a few years later, it was deemed fitting that a sum should be raised to provide a proper memorial to the father of American microscopy and his distinguished pupil, as a tribute due their services to the scientific world. The first notice of the movement was sufficient to bring, unsolicited, from the Royal Microscopical Society of London, a contribution for this purpose. Additional sums subscribed by the members and others, together with the natural increase under the careful management of the custodian, have brought the sum to a total at date of $756.00. The recent death of Herbert R. Spencer serves as the immediate impulse of this movement toward the enlargement of the fund to a point at which its income may be sufficient to encourage in some way the advancement of science. It is accordingly desired that this tribute to the Spencers, father and son, and to their co-worker, Mr. Tolles, should be increased at once to the sum of at least $1200.00, in order that the income therefrom may be offered each year under proper conditions as a reward for, or assistance toward, scientific work or investigation of suitable character.

"To this end a committee was appointed by the Society to lay the statement before the public and to ask co-operation in the effort to increase the fund, and to solicit such contributions toward that end as it may be deemed fitting to make. We believe that the object will appeal to every one who is called upon to use the microscope in any capacity whatever, and contributions will be welcomed from all. Remittances should be made to Mr. Magnus Pflaum, custodian of the Spencer-Tolles Fund, Bakewell Law building, Pittsburg, Pa., who will at once return proper receipt for same."

As this fund is practically the only one in America to be devoted to such a purpose, patriotism, if nothing else, should prompt a liberal support of the movement. One need only glance at the results of similar encouragement for investigation in Europe, to be convinced of its practical features.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to Charles J. Chamberlain, University of Chicago, Chicago, Ill.

REVIEWS.

Nawaschin, S. Beobachtungen über den feineren Bau und Umwandlung von Plasmodiophora Brassicæ Woron. im Laufe ihres intracellularen Lebens. Flora, **86**: 404–427, pl. 20, 1899.

Plasmodiophora is a parasitic Myxomycete which causes various deformities and distortions in the roots of its host. *P. brassicæ* is the cause of "club root" in cabbages and turnips. Woronin, who studied this form more than twenty years ago, found that it does not form sporangia, but that the spore masses lie free in the cells of the host. Eycleshymer, in the *Journal of Mycology* (**7**: 79-88, 1892), gives a clear account of the life history and distribution in the United States. The present paper is concerned with the more minute details. Infected roots were cut into very small pieces and were treated with Flemming's stronger solution for twenty-four hours. The author thinks that the advantages of a more prolonged treatment are entirely imaginary. Sections were cut two to three μ in thickness, and were fastened to the slide with distilled water without any further fixative. The Flemming triple stain gave the best results. Dilute Delafield's hæmatoxylin followed by eosin in clove oil, and also the gentian-violet method, according to Gram, gave good results. The peculiar method of nuclear division in the vegetative amœbæ is worthy of special mention. In the resting condition this nucleus has a membrane, a nucleolus, and an extremely delicate chromatin network. As division begins, clearly differentiated chromatin granules appear in the place of the network, the granules having no genetic connection with the nucleolus. A plate, evidently derived from the chromatin granules, is then seen near the nucleolus; at this stage there is a sort of one-sided "achromatic figure" with its base resting upon the chromatin plate, and its apex at the nuclear membrane, but the figure afterwards acquires a symmetrical aspect, the drawings in the plate bearing considerable resemblance to bipolar spindles. The nucleolus now divides transversely, and the two resulting bodies take positions on opposite sides of the chromatin plate, which is now a homogeneous disc with chromatin granules embedded in its periphery. The chromatin plate now splits, and the two parts, each accompanied by a nucleolus, move toward the poles of the spindle, and two daughter nuclei are formed. This method of division is of greater interest because the nuclear division in the plasmodium is simultaneous and of the usual bipolar mitotic type.

The author's summary of the entire paper is about as follows:

1. The group of infected cells arises by the repeated division of a primary infected cell.

2. During the growth of the infected cells numerous multinucleate amœbæ appear, which multiply without fusing to form a plasmodium.

3. In this condition the amœbæ of *Plasmodiphora* are remarkable for their structure, and especially for their unique mode of nuclear division.

4. The mode of nutrition of the amœbæ seems to be different from that in other myxomycetes.

5. As the amœbæ fuse into a plasmodium, characteristic changes take place in the structure of the body, and in the nuclei.

6. The formation of a plasmodium takes place only after the host cell is exhausted.

7. In the mature plasmodium, spore formation is preceded by repeated nuclear division of the typical mitotic sort.

8. In the first period of its development the parasite does not kill the host cell, but merely causes it to hypertrophy. C. J. C.

Jager, L. Beiträge zur Kentniss der Endospermbildung und zur Embryologie von Taxus baccata L. Flora, 86: 241–288, pl. 15–19, 1899.

The writer was fortunate in securing an abundance of wild material in all stages of development, but the technique seems rather primitive for such a paper as the title indicates. The material was fixed in absolute alcohol, embedded in celloidin and stained in hæmatoxylin or hæmalum, so that it is evident that the preparations could not be as valuable as they would have been if the material had been fixed in some of the chromic acid solutions and had been embedded in paraffin, thus facilitating serial sections and allowing the use of a greater variety of stains; still the work is an important contribution to its subject, and must be noticed by all students of embryology. The principal results are the following:

The origin of the aril shows it to be a second integument. In tracing the development of the embryo-sac he was not able to get the earliest stages. The two-, four-, and eight-cell stage of the embryo-sac were not observed, but many sacs were observed in later stages. Free nuclear division continues until there are about 256 free nuclei in the sac (the eighth division), when cell walls begin to appear. These cells rarely contain more than one nucleus, and have a regular six-sided appearance in optical section; in the later stages of endosperm formation the cells are often multinucleate. The formation of archegonia begins at the end of May or the first of June, but archegonia in very different stages of development are soon found in the same prothallium, even embryos and young archegonia often appearing together. The usual number of archegonia is from five to eight, but nine, ten, and even eleven were observed. Pollination occurs from the beginning to the middle of March, and the still undivided pollen grains come into direct contact with the nucellus and form the pollen tubes. There is no so-called pollen chamber. By the end of May three nuclei can be seen in the pollen tube, the tube nucleus and the nuclei of the stalk-cell and generative cell. Shortly before fertilization occurs, the generative cell divides into two very unequal cells. Fertilization takes place about the first of June. There may be several pollen tubes, and several "archegonia" may be fertilized. The sex nuclei, which are of about the same size, come into contact and then sink to the bottom of the archegonium, where fusion takes place. Nuclear division then proceeds until there are from ten to sixteen free nuclei at the base of the archegonium, after which the free cells become arranged into tiers, the upper tier

("rosette"), the middle tier consisting of embryonal tubes, usually six in number but sometimes more, and the lower tier which is the embryo proper. In *Taxus baccata* all the embryonal tubes of one archegonium belong to a single embryo. There are normally two cotyledons, but in one case three were observed. The embryo contains an abundance of starch. C. J. C.

CYTOLOGY, EMBRYOLOGY, AND MICROSCOPICAL METHODS.

AGNES M. CLAYPOLE.

Separates of papers and books on animal biology should be sent for review to Agnes M. Claypole, Sage College, Ithaca, N. Y.

CURRENT LITERATURE.

Kopsch, Fr. Homologie und phylogenetische Bedeutung der Kupffer's scheu Blase. Anat. Anz., **17**: 479–509, 1900.

The author first reviews the different theories held as to the significance of the vesicle in embryos of bony fishes. Three main opinions prevail: (1) It is considered to be the allantois by Kupffer and Henneguy. (2) It is considered the homologue of the terminal vesicle of the post-anal gut of selachians (Balfour, H. E. Ziegler, Kingsley and Conn, Agassiz, and Whiteman, Schwartz, Eigenmann, Wilson, H. Virchow, W. Berent, Felix). Oellacher's opinion that it is the rudiment of the end gut, and Henneguy's that it is this, together with the hind part of the mid gut, can both be included here. (3) It is the terminal part of the primitive archenteron (Henneguy, Ryder, Cunningham, Miez, v. Kowalewski, List, Wilson). The development of this structure is first described by Kupffer, but it was earlier figured and described by Coste and Lereboullet. Henneguy believes the vesicle to be the homologue of the allantois, and also that the allantois of higher vertebrates is an outgrowth of the alimentary tract, Kupffer's vesicle then representing the primordial cavity of the alimentary tract. According to modern investigations this view is untenable, since the vesicle is placed behind the spot where the anus and urinary bladder develop. The second view, that the vesicle corresponds with the post-anal section of the alimentary tract, was first advanced by Balfour, and had many adherents. Oellacher and Henneguy, among these, were aware that the time of the appearance of the vesicle precedes that of the fore part of the alimentary canal, also that it includes the rudiment of the hind gut. But they did not grasp its relation to the post-anal gut. The third view, that of its relation to the primitive archenteron, was held only for a short time unconditionally by three authors (Ryder, Cunningham, Kowalewski). Three other authors (Henneguy, List, Wilson) accepted it with modifications. Sobotta announced categorically two years ago that without doubt the vesicle had a direct relation with a part of the archenteron. He based his opinion on the fact of the similarity of development between the vesicle in teleosts and the archenteron of selachians. In this way the arrangement of the layers in the hinder end of the embryo, to correspond to

the neurenteric canal, is firmly established. The vesicle was not considered to correspond to the whole archenteron, but just to a part, as could be seen with a superficial consideration.

Taking up the facts for this conclusion in turn, the author says that it is not right to infer, as can be done with bony fishes, owing to a late appearance of the archenteron, that at the time of gastrulation a primitive entoderm is present. Since a retarded appearance of archenteron (alias Kupffer's vesicle) does not take place with teleost embryos, a causal connection between the retardation and the unknown physiological significance of Kupffer's vesicle cannot be traced. (2) The kind of delimitation of Kupffer's vesicle determined for the teleosts so far investigated agrees with some of the conditions of the so-called archenteron of selachians, as in the two organs the dorsal wall is formed from the entoderm and the ventral from the yolk syncitium, in which point, according to Sobotta, there exists a special agreement, because the ventral wall almost always in Belone, also in Trutta, is significantly free of nuclei. Whether this special agreement has any morphological significance is doubtful, in view of the fact that the author has found it true only in the case of Belone, and not a constant feature even there, a fact which the present author confirms from his Belone material. The delimitation of dorsal entoderm and the ventral yolk syncitium does not belong exclusively to the vesicle, but is equally true of the whole of the alimentary tract so long as it has not become a closed tube, and hence this fact cannot serve as evidence for the homology of the Kupffer's vesicle with the archenteron of selachians, but shows rather that it, together with the part of the alimentary tract anterior to it, is similarly placed in reference to the so-called archenteron of corresponding selachian embryos. (3) The arrangement of the layers to correspond with the neurenteric canal should speak for its connection with the archenteron. Here it must be remembered that the neurenteric canal arises at the end of gastrulation, and truly at a time when the neural canal has been formed from the gastrula, when an archenteron no longer exists, but an embryonic alimentary tract has arisen. The neurenteric canal does not open into the archenteron, but into the hinder end of the embryonic alimentary tract, so that the place-relation of the Kupffer's vesicle to the ideal neurenteric canal of bony fishes is no evidence for the archenteric nature of the same. At least one can speak of the archenteric nature of the vesicle in so far as the relations of the hind end of the gastrula are preserved in a certain measure, this part of the embryo being the zone of growth. In spite of that, the vesicle should not be erroneously homologized with the archenteron of teleosts, for in so doing the tail end is called the gastrula.

Sobotta's three arguments go to prove that the vesicle belongs to the alimentary tract, and corroborate Balfour's homology of this structure with the terminal sac of the post-anal gut of selachians. The structure appears first in an embryo (Trutta) which has long past the gastrula and neural groove stages, an embryo in which the fundiments for all the organs of the fore-body segments, to the number of 7 to 10, have been laid down. The preoral portion of the alimentary canal, the mouth, gill chamber, and part of the œsophagus are all formed. The homology of the vesicle, with the terminal vesicle of the post-anal alimentary tract of the selachian embryo, may be based on the following facts:

The zone of growth of selachian and bony fish embryos is completely homologous. With older selachian embryos the entodermal portion of the growth zone grows through the terminal sac of the post-anal gut, which arises from the lower half of the neurenteric canal or from the entoderm placed near the neurenteric fold of younger stages. With older bony fish embryos the entodermal part of the zone of growth is reduced to a trace; in younger stages it is present in the form of Kupffer's vesicle. This sac and the post-anal gut of selachians are homologous structures, as can be further seen from their manner of growth and their relations to surrounding structures. The phylogenic significance of these structures, Kupffer's vesicle and the the terminal sac of the post-anal gut, lies in the differences of their times of appearance. In bony fishes Kupffer's vesicle disappears early, in selachians it continues later and later in the group. This time relation is caused by the early origin of the single tail end in teleosts, and the union in selachians of the two caudal folds into one growth zone. Depending on the fact that the tail is a body segment morphologically equivalent to the others in which the same dorsal and ventral parts are present, also on the presence of a post-anal gut and neurenteric canal, it can safely be assumed that the alimentary tract of the vertebrate ancestor opened at the terminal part of the body. It is no cause for wonder that the selachians have preserved these conditions more completely than the teleosts, and Kupffer's vesicle is considered by the author to be a part of the original neurenteric cloaca, as evidenced by its relations to the neurenteric canal and hind end of the body.

Féré, C. H. Abnormalties in Development of Chick. Jour. Anat. Physiol., Sp. 99–102, 1 pl., 1900.

In this short paper the author shows as also have other writers, that in the course of development the same sequence and relations in the embryonic areas are not always maintained. Cases have been described in which the *area opaca* developed in the absence of embryo, showing that the *area opaca* and *area pellucida* are to a certain extent independent of each other. Also in the *area opaca* the vascular and non-vascular areas are not very closely related to each other, since one may develop independently of the other. An interesting case is described by the author in which the non-vascular part of the *area opaca* developed but slightly, resulting in a blastoderm, which consisted of a somewhat abnormal embryo within the surrounding vascular area resting almost directly on the yolk. This condition can be described as complementary to the commoner condition, in which the non-vascular zone develops at the expense of the embryo.

Stahl, Prof. E. Influence of Direction of Light on Division of Equisetum Spores. Ber. Deutch. Bot. Gesell. III, 85, 334–40.

Direction of division of microspore depends on direction of rays of light, daughter microspore lying in that direction. Nucleus on dark side equals that of root-cell, other equals prothallium cell.

NORMAL AND PATHOLOGICAL HISTOLOGY.

RICHARD M. PEARCE, M. D.

University of Pa., Philadelphia, Pa., to whom all books and papers on these subjects should be sent for review.

Manasse, Paul. Multiple Amyloid Tumors of the Upper Air Passages. Virchow's Archiv., **159**: 117, 1900.

Amyloid tumors are most frequently described as occurring in the conjunctiva, next in frequency in the upper air passages. They are rare, however, even in these situations.

Manasse's case was a male, sixty-three years old. On the posterior wall of the larynx and the trachea was a large flat tumor 3.2 cm. long, .8 cm. thick. On section glassy, transparent, and of woody consistency. Near it on the right side was a similar tumor 2.2 cm. long, .8 cm. wide; many small tumors were scattered over larynx and trachea to third tracheal ring. On addition of Lugol's solution, surface turns deep brown in color. Microscopically it showed little structure; consisting of clear, transparent tissue which gave amyloid reaction; also contained hyaline cartilage, probably formed metaplastically from connective tissue. The amyloid material was situated in the lymph vessels. R. M. P.

The Histology of Acute Lobar Pneumonia. Pratt (Welch's "Festschrift," 1900) gives the results of a histological study of fifty cases of acute lobar pneumonia. The tissues were hardened in Zenker's fluid, embedded in paraffin, and the sections stained with eosin followed by Unna's alkaline methylen blue solution.

In the early stages of the disease the alveoli contained many cells almost identical in appearance with the transitional cell of the blood. They were usually slightly larger than the polymorphonuclear leucocyte, the nucleus was irregular in shape and vesicular, the protoplasm contained either a few granules or was homogeneous. In a case in which death occurred eleven hours after onset, there were many of these cells in the exudate, and no polynuclear leucocytes.

The origin of these cells is uncertain, but probably they arise from proliferation of the epithelial cells lining the alveoli, as many mitotic figures were found. They may be transitional cells which have emigrated from the blood vessels, but no emigration could be demonstrated. Similar cells occurred in the lymphatics and in the pleural exudate.

After the first forty-eight hours, the predominating cell in the exudate was the polynuclear leucocyte. It is phagocytic for bacteria, but not for other cells.

Large phagocytic cells were found in the exudation in all stages of the disease, but in greatest number in gray hepatization. They probably are the cells mentioned above as derived from the alveolar epithelium. In proof of this is the fact that the cells, while still attached to the walls of the alveoli, are phagocytic. The inclusions in these cells are chiefly polynuclear leucocytes and lymphocytes, more rarely red blood globules. Similar phagocytic cells occur in the lymphocytes, in the pleural exudate, and in the bronchial lymph nodes. In the pleural cavity they are derived from the lining epithelium; in the lymphatics and lymph nodes, from the endothelium.

The fibrin in the exudation usually is more abundant in the peripheries of the alveoli than in the centers. Strands of fibrin and even bundles of fibrin threads often pass directly through the alveolar wall from one alveolus to another. Thrombi were noted in one-half of the cases; usually only the small vessels and capillaries were affected. Fibrinous thrombi predominated. Emboli composed of giant cells from the bone marrow were found frequently. The lymphatics were involved late in the disease, there was proliferation of their endothelium and they became distended with cells, serum and fibrin. In cases dying during the second week there was often a great infiltration of the interstitial tissue with lymphoid and plasma cells. As a rule, the longer the duration of the disease, the greater the number of plasma cells. R. M. P.

Cox, Ulysses O. A Syllabus of Elementary Physiology with References and Laboratory Exercises. Department of Biology, State Normal School, Mankato, Minnesota; Free Press Printing Co., Mankato, Minn., pp. VIII+167, 8 figures.

Although intended primarily for the author's own classes, this syllabus will be found to be very practical and useful by all teachers of physiology in secondary schools. The various chapters deal with the cell; supporting tissues; motor tissues; digestive organs, foods and digestion; circulatory tissue; respiratory tissues and respiration; excretory tissues; nervous tissues; special senses and the voice. A list of forty of the most serviceable books in English on physiology, hygiene, zoölogy, and histology is given. An appendix contains directions for the preparation of anatomical and histological material. Each chapter opens with a list of references to the appropriate pages of the books mentioned dealing with the subject matter of the chapter, and ends with a series of directions for the practical examination of the specimens to be studied in connection therewith.

Since in many schools the course in physiology precedes those in physics and chemistry, the introductory chapter is devoted to such simple experiments as the pupil should be familiar with before proceeding to the study of physiology proper. These outlines for study are considered to be so general, that they may be used in connection with any modern text-book. The manual is one which may safely be commended as one of the most useful laboratory guides in elementary physiology. CHARLES WRIGHT DODGE.

Dept. of Biology, University of Rochester.

NEWS AND NOTES.

PRESERVATION OF MEDUSÆ.—Everyone who has tried it knows the difficulty of preserving medusæ. According to this method they are killed by adding a few drops of concentrated chromic acid to the sea water containing them. Then place in fresh sea water and continue to change the water until every trace of chromic acid has disappeared; gradually add glycerin and alcohol to the water and increase the proportions until you have the medusæ in pure glycerin and alcohol, which should be mixed in proportions to make it of the same specific gravity as sea water.

FISSION.—*Dero vaga*, one of the Naids, may be used for the study of this

mode of reproduction. It builds a case of statoblasts, Arcella shells, leaves of Lemna, etc., and concealed in this way it swims about among the plants in shady ponds and ditches. During the first two weeks of July it reproduces sexually, but asexual reproduction by fission may be observed throughout the year. After division the daughter worms break the case apart, and each swims away with its half. Lost parts, including the head, are regenerated.

ROTIFERA.—Treat with one per cent. osmic acid for five or ten minutes, wash, leave for twenty-four hours in a two per cent. solution of chromate of potassium, wash thoroughly again, and stain from two to twenty-four hours in borax or picro-carmin. Decolorize with acid alcohol.

HUMAN EMBRYOS.—Erlicki's solution, consisting of 2.5 parts of potassium bichromate, one part copper sulphate, and 100 parts water, is a convenient hardening agent, and acts more rapidly than Müller's fluid. To isolate epidermis, Minot leaves the specimen for several days in a six-tenths per cent. solution of common salt, with one-tenth per cent. thymol as a preservative. This treatment frees the embryonic epidermis so that pieces are easily removed. Such material is well adapted for histological examination, although the nucleus is not always perfectly preserved. A saturated aqueous solution of corrosive sublimate is also a good fixing agent for the earlier stages of development.

MAGNETISM IN EMBRYOLOGY.—Eggs kept under the influence of strong magnets developed only about one-fourth as many chicks as a similar series without magnets, and the chicks hatched under these conditions died in greater numbers than the others.

SNAILS' EGGS.—The carbonate of lime may be removed from the external membrane of the ova of *Helix* and the ova fixed at the same time by leaving them for four or six hours in Mayer's picro-nitric solution (nitric acid five parts, water 100 parts, picric acid to saturation). The albumen may then be picked away with needles, and the ovum hardened and dehydrated with alcohol and embedded in paraffin.

A supply of embryos of *Limax maximus* may be obtained by keeping a number of the slugs in a large tin pail in the laboratory, where they may be fed with cabbage leaves. The slugs are fastidious, and it is necessary to keep their surroundings perfectly clean. The cover of the pail may be perforated to admit the air, or the pail may be covered with wire netting. Ova are deposited in bunches of thirty or forty, and hatch in from twenty-two to twenty-seven days. They must not be allowed to dry. In fixing, remove the outer membrane and place in thirty-three degrees chromic acid, and remove the inner membrane after two or three minutes. Perinyi is also a good fixing agent, but both membranes must be removed before treating with it.

ANCYLUS RIVULARIS *Say*.—These are fresh water forms and may be kept in aquaria, where they will deposit their ova in small, transparent, colorless capsules, one in each capsule. Unequal division begins at the eight-celled stage, and the spiral is sinistral. Kofoid keeps *Limox* in a well-ventilated metal box containing about two cm. of sand, with a layer of moss. He feeds them on plantain leaves, or, if these are not available, apple parings or cabbage leaves. Eggs are deposited mostly

at night. The egg must be freed from its gelatinous envelope before fixing. Fasten two needles in a holder in such a way that the distance of the points shall be not quite as great as the diameter of the egg, hold the egg with this under normal salt solution, and pull the capsule open with another needle. Wash away the albumen with a pipette, taking care not to let the slimy mass between the inner and outer membrane come in contact with the ovum, as it is very difficult to remove. The embryo is then removed with a pipette and placed in fixing fluid. *Paludina* has two forms of spermatozoa, one form hair-like and about 88 μ. long, the other worm-like, about 180–190 μ. long. The hair-like forms have a slender body, narrowing into a delicate thread at the tail, and a head shaped like a corkscrew with six turns. The worm-like form is cylindrical, and terminates posteriorly in a bunch of fine cilia. The spermatozoon has an axial thread made up of fine fibrils, each corresponding to a terminal cilium, and this thread, with an enveloping protoplasmic sheath, makes up the body of it.

MOTION OF SPERMATOZOA.—De Witz studied *Periplaneta orientalis*, one of the cockroaches. The sperms were kept in .8 to .9 per cent. salt solutions, in which media they were seen to be attracted to surfaces, on which they move in circles in the direction opposite that of the hands of a watch. In visceral fluids the course was regular.

PERMANENT MOUNTS OF SPERMATOZOA.—Place fresh spermatozoa in a watch glass containing a mixture of equal parts of glycerin and water, with a single drop of osmic acid. Distribute them thoroughly through the fluid by stirring with a needle, place drops of the solution on a slide by means of a pipette, and seal the mounts with gold size. The outline of the cell is sharpened and the nucleus made more prominent, but otherwise the appearance of the cell is unchanged. Iodized serum is recommended for the examination of the spermatozoa of the small cockroach (*Blatta germanica*). The serum should be rubbed up with dahlia and filtered.

DAPHNIA PULEX, *Moina*, *Evadne*.—In *Daphnia* the broad pouch thickens, and is thrown off for a protection to the winter eggs. The Branchiopoda also have parthenogenetic eggs. Includes *Apus*, *Lunnadia*, *Estheria*, etc.

SPERMATOZOA OF POLYPHEMUS PEDICULUS.—*Polyphemus pediculus*, belonging to the Cladocera, has amoeboid spermatozoa which may be made specially active by placing in a three per cent. salt solution. When placed in ten per cent. sugar solution some become spherical, and other spindle-shaped ones give off a very long pseudopodium, the length of which may equal that of the male *Polyphemus*.

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MICRO-CHEMICAL ANALYSIS.

VII.

THE ANALYTICAL REACTIONS OF GROUP I.

Na, K, Rb, Cs, NH_4, Li.

In the previous papers of this series the apparatus, reagents, and operations used in qualitative analysis by micro-chemical methods have been described. In the remaining numbers of the series an attempt will be made to explain and discuss the tests which can be employed for the detection of the elements most frequently met with in ordinary analytical work.

These papers will follow quite closely a course which has been given to my students in the form of lectures and laboratory work, and are based upon the system of Dr. Behrens.

An attempt will be made to present the matter in such a way as to bring out the important chemical facts involved, and, by suggesting a series of experimental practices, help the beginner to better appreciate the similarities and differences between the elements. In order to emphasize this, the elements will be taken up according to their grouping in the Periodic System of Mendeléeff. Unless thoroughly familiar with this table the worker in micro-chemistry should ever have a copy of it before him.

The majority of the reagents and tests have now been in use many years, and in most instances the methods of applying the tests are the result of gradual improvement in which more than one investigator has had a hand. It has, therefore, been thought unnecessary to give the list of authorities save in special cases.

That method of applying the reagent will be given which has furnished the most uniform results in the hands of students.

The cuts used to illustrate the appearance of the crystals have, in all cases, been drawn by the writer from nature, by means of the camera lucida. The magnification of the objects has been indicated by sketching a few spaces of a stage micrometer at the corner of the drawings. Measurements have not been given, for, although with practice, in any test like conditions, and thus crystals of approximately the same size can be obtained, the beginner often finds difficulty in controlling these conditions.

It has been deemed advisable to give the probable reaction taking place in each test; but since we are dealing with crystallizations, a perfectly accurate equation is seldom possible. Although in ordinary equation writing, water of crystallization is seldom, if ever, indicated, it has been thought necessary to write the reagents and the principal product just as they exist in the experiment. Moreover, the presence, absence or variation in the amount of water of crystallization in a compound forming different hydrates, almost invariably changes its crystal system. The equations, however, have not been balanced with respect to the water of crystallization. In all cases where there is some doubt as to the reaction or the formulas of the salts, the authority followed has been designated.

Experience has shown that the best plan by which to acquire the knowledge so necessary for the correct interpretation of results, is first to perform each test in turn on a simple salt of the element; then to make mixtures of known salts and attempt to detect the different components.

In describing the means to be employed for the detection of the various elements, the following scheme will be adopted: 1. Reagent to be used and reaction taking place. 2. Method: the manner of applying the reagent and the appearances to be obtained. 3. Remarks: a discussion of the sources of error, usefulness of the test, etc. 4. Suggestion of experiments for obtaining practice in the methods.

SODIUM.

The following are the most important of the reagents which have been suggested for detecting this element:

I. Uranyl acetate.
II. Uranyl acetate combined with magnesium acetate or with zinc acetate.
III. Ammonium fluosilicate.
IV. Bismuth sulphate.
V. Potassium antimonate.
VI. Platinum chloride (Chlorplatinic acid).
VII. Picric acid.
VIII. Cerous sulphate.
IX. Tartaric acid.
X. Conversion into alums, double sulphates, etc.

I. Salts of Sodium form, with Uranyl acetate, Sodium Uranyl acetate, according to an equation which can be written:

$$Na_2SO_4 + 2\ UO_2(C_2H_3O_2)_2 + 2\ HC_2H_3O_2 = 2\ [NaC_2H_3O_2 \cdot UO_2(C_2H_3O_2)_2] + H_2SO_4.$$

Method. Place at the corner of a clean slide a small drop of distilled water. Add to this a fragment of the material to be tested, which has already been brought into a soluble condition. Stir until dissolved. Evaporate to dryness over a small flame; avoid boiling (sodium may be extracted from the glass). Examine under the microscope to see whether a thin, uniform film has resulted. (See this Journal, Vol. III, p. 856.) Near the residue (2–3 mm.) place a drop of distilled water; acidify by touching with a glass rod or Pt. wire which has

been dipped in acetic acid; introduce one or two grains of uranium acetate. Warm the drop gently to facilitate solution, but do not evaporate. Cool. By a single light and rapid stroke of a glass rod or Pt. wire, draw a streak of the reagent across the center of the dry material to be tested. Examine *at once* along the edges of the streak. If sodium is present there should appear tiny triangular crystals of the double acetate of sodium and uranyl, growing to light yellow tetrahedra (Fig. 23). Modifications of the tetrahedron are also to be seen. This double salt belongs to the isometric system.

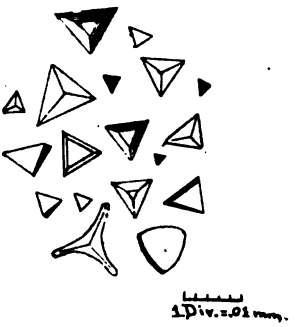


Fig. 23.

Remarks. It is not an easy matter to obtain in commerce uranium acetate free from sodium. The writer has met with samples of this salt marked—C. P.— by reputable firms, which consisted almost entirely of the double acetate of sodium and uranyl.* It is of prime importance, therefore, that when purchasing this reagent for micro-chemical analysis, it be ordered free from sodium (also free from magnesium and zinc, both of which may possibly be present in small amount). Always test the reagent before using; but in this testing it should be borne in mind that any sodium found may have come from the acetic acid or from the distilled water employed, these having been kept too long in small vials. If it is desired to remove the possibility of any sodium having come from the glass slide through corrosion, celluloid slips can be used.

When properly performed this is a most excellent, reliable, and characteristic reaction. There is generally no difficulty in distinguishing the double salt from the crystals of uranium acetate. If in doubt, examine with crossed Nicols. The double salt is isometric, while $UO_2\ (C_2H_3O_2)_2 \cdot 2H_2O$ is orthorhombic and $UO_2\ (C_2H_3O_2)_2 \cdot 3H_2O$, tetragonal.†

When the crystals are not well developed, it is advisable to recrystallize by breathing on the preparation or by adding a very minute drop of water. In the majority of cases the first formation of crystals is always to be preferred for examination.

The relative abundance of the crystals of the double acetate will give an indication of the relative amount of sodium present in the material being tested.

It is essential that there be sufficient uranium in solution, and that the test be examined before the liquid of the streak has evaporated.

The reaction fails in the presence of strong acids. Hence, if such are present, first drive them off on Pt. foil; then dissolve in water and transfer to a glass slide. Ammonium acetate cannot be employed in this case to mitigate the action of the acid, as is usually done.

Failure may also result if the solutions used are too dilute; hence the evaporation to dryness suggested.

Platinum chloride interferes; therefore the material must be first tested for sodium; then the platinum test for potassium (q. v.) can be applied.

* Other workers have reported similar experiences.
† Fock, Krystallographisch-Chemische Tabellen.

When members of the Calcium Group are present in large or even in moderate amount, it is advisable to remove them, since these elements tend to form double acetates corresponding to the general formula: $M(C_2H_3O_2)_2 \cdot UO_2(C_2H_3O_2)_2 \cdot 6H_2O$. Treat with sulphuric acid; evaporate on platinum; add carefully a drop of water; draw off (see p. 851); evaporate to dryness, driving off any excess of acid, and proceed as above.

Much potassium (Rb or Cs) is sometimes apt to mask the sodium test, particularly when the latter is only in minute amount. In such cases add tartaric acid; allow the drop to evaporate spontaneously, add a tiny drop of water; draw off; evaporate; destroy the tartaric acid in this residue by heating with sulphuric acid; take up the residue with water and proceed as usual.* (Behrens.)

Ammonium salts interfere with the reaction if present in excess. This is doubtless due to the fact that ammonium forms with uranium acetate a double salt of the formula: $NH_4C_2H_3O_2 \cdot UO_2(C_2H_3O_2)_2$, tetragonal. Remedy: heat some of the original substance on Pt. foil until all or nearly all the ammonia has been expelled. Avoid heating too hot, for if chlorides are present the sodium may itself be volatilized. The residue on the foil is transferred to a glass slide and tested.

In the presence of phosphates and other compounds forming insoluble precipitates with uranium, it is sometimes difficult to obtain satisfactory reactions. In the event of the appearance of an amorphous precipitate of uranium salts, take a new portion of the substance, acidify with hydrochloric acid, add an excess of the reagent and *at once* draw off the clear liquid. Evaporation of this clear solution will generally yield a good test.

The formation of the typical *double* acetate of sodium and uranyl is modified by the presence of a number of elements; the most important of which are, *Gl*, *Mg*, *Zn*, *Cd*, *Fe*, *Mn*, *Co*, *Ni*, *Cu*. These elements give rise to the formation of *triple* acetates. Advantage is taken of this fact to obtain an even more delicate test for sodium, which is discussed under Method *II*.

Exercises for Practice. Method I.

Try reaction according to above method on sodium sulphate and sodium phosphate.

Then in exactly the same manner try with salts of K, Rb, Cs, NH_4, Li. Note that tetrahedral crystals are formed only (if materials are pure) in the case of Na salts, and that there can be no danger of confusing by this test any other member of the group with sodium.

To a solution of sodium chloride add an excess of ammonium chloride. Remove a small drop and test. Place another drop of like size on Pt. foil and expel the ammonium salt. Test the residue for sodium. Note that in the absence of NH_4 a far better test is obtained.

Try method on a mixture of calcium and sodium salts. Remove the calcium and test again.

* N. Schoorl (Nederl. Tijdschr. Pharm. 12, 116) has recently suggested another method for removing potassium. Evaporate repeatedly with perchloric acid. Extract the residue with alcohol. Potassium perchlorate is undissolved while the sodium salt passes into the solution. Evaporate the alcoholic extract and test for sodium with uranyl acetate.

II. Salts of Sodium form with Uranyl acetate, in the presence of Magnesium acetate, a triple salt of the formula:

$[NaC_2H_3O_2 \cdot Mg\,(C_2H_3O_2)_2 \cdot 3UO_2\,(C_2H_3O_2)_2 \cdot 9H_2O]$.

The reaction taking place is analogous to that given under Method *I*.

Method. Proceed exactly as in *I*, save that to the reagent drop, a little magnesium acetate is added before drawing it across the material to be tested. The triple salt soon forms in very faintly yellowish rhombohedral crystals, growing to a larger size than those of the double acetate of sodium and uranyl. See Fig. 24. Scalenohedral crystals are also seen. Owing to the growth of secondary faces, some of which become unduly developed according to the positions in which the crystals lie, a variety of crystal forms result which are apt to greatly puzzle one as to their nature.

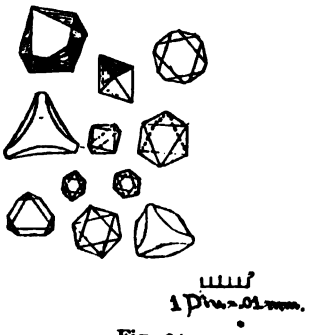


Fig. 24.

Remarks. Magnesium acetate alone forms with the uranium salt a double acetate of the formala: $Mg(C_2H_3O_2)_2 \cdot 2\,UO_2(C_2H_3O_2)_2 \cdot 7H_2O$, orthorhombic. This salt is readily made, and can be utilized as a reagent for sodium instead of proceeding as directed above. In some respects this is preferable to using the saturated solution of magnesium acetate, since the latter rapidly becomes unfit for use by taking up sodium from its container.

Double acetates of like formulas are also known of the elements Zn, Ni, Co, Fe. Probably Gl and Cd should also be included in this list. It follows from this fact, and in accordance with their position in the Periodic System, that any of these elements can be substituted for magnesium. It is obvious that this is especially true of Gl, Zn and Cd. Where the presence of zinc will not interfere with subsequent operations, it is a decided advantage to employ zinc acetate in the place of magnesium acetate.

The solubility of the triple acetates can be lowered by the addition of a little alcohol; but it is seldom indeed that it is necessary to hasten crystallization in this manner.

Owing to the bulky molecule formed, and the fact that it contains only a very low percentage of sodium, the delicacy of the reaction is considerably greater than that of *I* (about twice).

Unless the amount of sodium present in the material being examined is small, tetrahedral crystals of the double acetate will appear and the triple salt will only be obtained after some time. A great excess of magnesium or zinc acetate should be avoided.

In general, the remarks made concerning interferences in Method *I*, hold good in this case also. Like remedies can be utilized to overcome them.

It is evident that if a substance under examination containing magnesium (or other member of this family) as well as sodium, is tested by Method *I*, in all probability no crystals of the double acetate will be obtained, but there will appear instead, the beautiful crystals of the triple acetate; thus giving an indication, in one single operation, of two or more elements.

If on testing a substance no tetrahedral crystals are obtained by *I*, it is unsafe to conclude that *no* sodium is present. A test should be made by *II*. The latter test may now show that sodium is really present, but in too small amount to have been readily detected by the first method. Aside from its practical value as a test, the formation of the triple-acetates is of great theoretical interest, since it brings out in a striking manner the close relationship existing between the different members of the same group (Mg group and allied elements) as well as the difference between members of a group (group of the alkali metals).

Exercises for Practice. Method II.

Try reaction, as indicated above, using magnesium acetate and uranyl acetate on a sodium salt.

Repeat, using, in place of magnesium acetate, first zinc acetate, then cadmium acetate. Note that the comportment of these elements is exactly similar, and in accordance with their position in the periodic system.

Test the method on salts of K, Rb, Cs, NH_4, Li, noting well the results obtained.

Make a mixture of sodium and magnesium salts. Test by Method *I*.

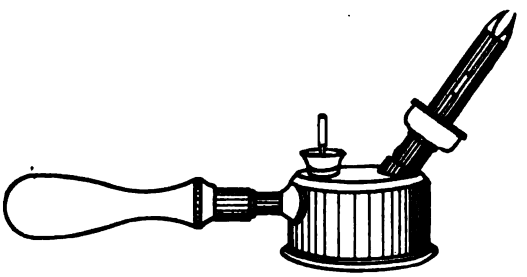
Use as a test substance a mixture containing Na, Mg, Ca.

Chemical Laboratory, Cornell University. E. M. CHAMOT.

(To be continued.)

A Portable Blast Lamp.

A few years ago, while conducting some field experiments, several miles from the laboratory, which required the heating and bending of a large number of glass tubes, the writer was put to much inconvenience and delay on account of proper facilities for doing the work. An alcohol lamp and blow-pipe were tried, but the glass was so hard that it was impossible to make the bends, and we were forced to send back to the laboratory for the required tubing. Thinking that others might have experienced the same difficulty, and also as a suggestion to teachers in preparatory schools where alcohol lamps are used in place of gas, a short description of a piece of apparatus now in use in our laboratory may not be out of place.



It is a small naphtha torch, such as plumbers use for thawing ice in pipes, etc. It has been in use for several weeks and proves very satisfactory, not only for the purposes mentioned, but for many others where a high degree of heat is required; in fact it makes a good substitute for a blast, generating much more heat than an ordinary Bunsen burner. To light the torch, a small amount of naphtha is placed in the cup at the base of the burner, this is lighted, and the heat from its burning generates the gas in the tank, which escapes through a

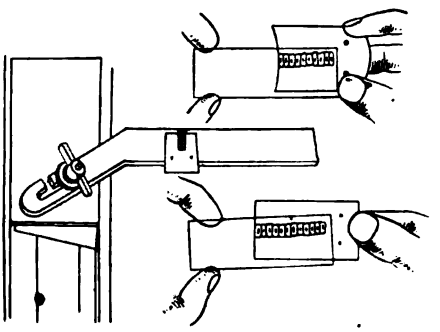
small opening and ignites at the end of the burner. No pump is required to provide pressure for the gas. For bending glass tubes we obtained a piece of brass tubing about one inch long and just large enough to fit snugly in the burner; one end of this tube was flattened carefully and rounded. Then a slit cut down about one-half inch. After a little experimenting the proper shape was secured to give the necessary "fish-tail" flame. W. J. MORSE.

Montpelier Seminary.

A Method of Procuring Ribbons With a Microtome Working Horizontally.

Having nothing but a sledge microtome at hand, and it being necessary to procure ribbons of embryos, the following method was employed. The cutting edge of the microtome knife was placed parallel to the edge of the block of paraffin to be cut, and on that part of the knife where the cutting was to be done, a common visiting card was placed to receive the ribbon. As the upper surface of the knife is not horizontal when set for work, the card was pierced by two pins sticking down past the back of the knife. The pins should be near the sides of the card so as not to strike the block of paraffin when the knife is drawn. They keep the card from sliding out of position and over the cutting edge of the knife.

Generally there is but little trouble in getting the sections loose from the knife by lifting the "pin" end of the card, which is next to you in cutting, and pushing the other end along the surface of the knife and away from you past the cutting edge. If the edge of the last section cut holds on to the knife so that there is danger of overturning or displacing the ribbon, place a scalpel lightly over the last section cut and push the card as described above. It was found that there were one or two advantages in the use of the cardboard over the common method of using something stiffer, as is the usual custom, —judging by the illustrations in texts—when it comes to transferring the ribbon to the slide. By holding the end of the card edgewise between the thumb and first finger and bringing the second finger up under the card with gentle pressure, the card is bent sufficiently to bring only the surface of the ribbon in contact with the slide. In case something like creasote-shellac solution is being used, this allows of little or none of it adhering to the card. In case a card does become sticky it is but the work of a moment to fix another for work. It would seem from the above advantages it would be better to employ cardboard in all cases, even with a Minot Automatic or other microtome working vertically.



It has been found best to turn the slide upside down in transferring, rather than the card, especially where some solution is used for making the sections fast. In that way one can see through the slide to arrange the sections, a very

essential thing where only two or three sections stick together, as is often the case when the paraffin is especially refractory. We have never heard of a microtome room to be heated to the desired temperature in winter, but it is the plan to have such a room in conjunction with our laboratory about to be built. Help to some other worker under difficulties has prompted these paltry suggestions.

CHAS. BROOKOVER.
Colorado College.

On the Preparation of Vegetable Epidermis for the Study of the Stomata.

The best plants for this purpose and those yielding typical stomata will be found among those with parallel veined leaves, such as Polygonatum biflorum, Tradescantia, Plantago, Phrynium, etc. The Echeveriæ yield up their epidermis very readily, but could hardly be considered good material for class study, as the stomata are very small. I would recommend Polygonatum as the best for school use; the epidermis comes off very easily and the stomata are large and very distinct. For temporary mounts a one-half per cent. normal salt solution is the best medium. In the cases of Polygonatum and Tradescantia, the stomata will be found in quantity on the under surface and near the base of the leaf, but very seldom, if at all, on the upper surface. A sharp-pointed scalpel should be pushed through the leaf from the under side and then turned down, and again passed through the leaf, bringing the point back to the under side. The part of the leaf held on the blade of the knife should be broken loose from the end nearest the apex and then slowly torn from the other end toward the base. For a little way the entire thickness of the leaf will tear, but will finally taper down and leave nothing but the under epidermis.

The entire piece should now be immediately transferred to a slide which has been prepared with fixative, and pressed down, after which the thick end of the piece must be cut off, leaving nothing but the epidermis. It would be well to examine the specimen before going any farther, to see if any of the inner tissues of the leaf have come away with the epidermis, and if present, they may be removed by the application of a drop of strong HNO_3. If not left too long, this will not injure the epidermis, and will entirely remove any other tissues which may be present. After this, thoroughly wash in H_2O, drain off and apply 35 per cent. C_2H_5OH. Stain with Delafield's hæmatoxylin thirty minutes, or carbol fuchsin one minute, decolorize in acidulated C_2H_5OH, dehydrate and mount in glycerin. The mounting medium should be composed of:

4 parts glycerin,
6 parts C_2H_5OH absolute.

Apply to specimen three or four times, allowing about twenty minutes to each application for the evaporation of the alcohol; then put on cover-glass, but do not seal for several days. This insures the removal of any H_2O, which may have been present in either the glycerin or C_2H_5OH.

R. P. WOODFORD.

Conochilus and Vorticella as Commensals.

These organisms were first found associated together in 1895 in Lake Whitney, one of the sources of the New Haven water supply. Although during several years I searched again for specimens, none were found until last year, 1899, when I found abundance of Conochili, but a smaller percentage of the colonies contained Vorticellæ. No specimens of the first collection were preserved, and no photographs taken. The photographs illustrating this note were taken from specimens preserved in formalin, in which they had remained nearly a year. They were photographed rather hastily, and without special preparation or staining. The Vorticellæ (Fig. 1) had become separated from the Conochili (Fig. 2) in the formalin, and it was impossible to exhibit them in situ; but the description which follows, together with the picture of the Vorticellæ, will, it is hoped, show the significant features of the case. The Conochili are, of course, in a state of contraction. My notes, made at the time of the first observation in May, 1895, are as follows:

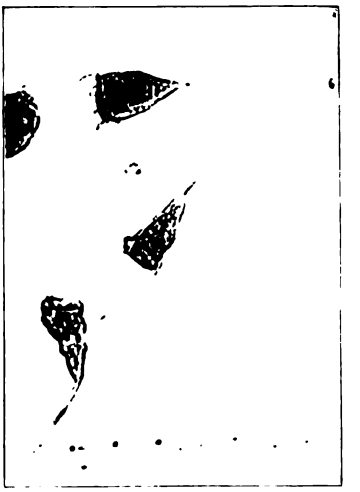


Fig. 1.

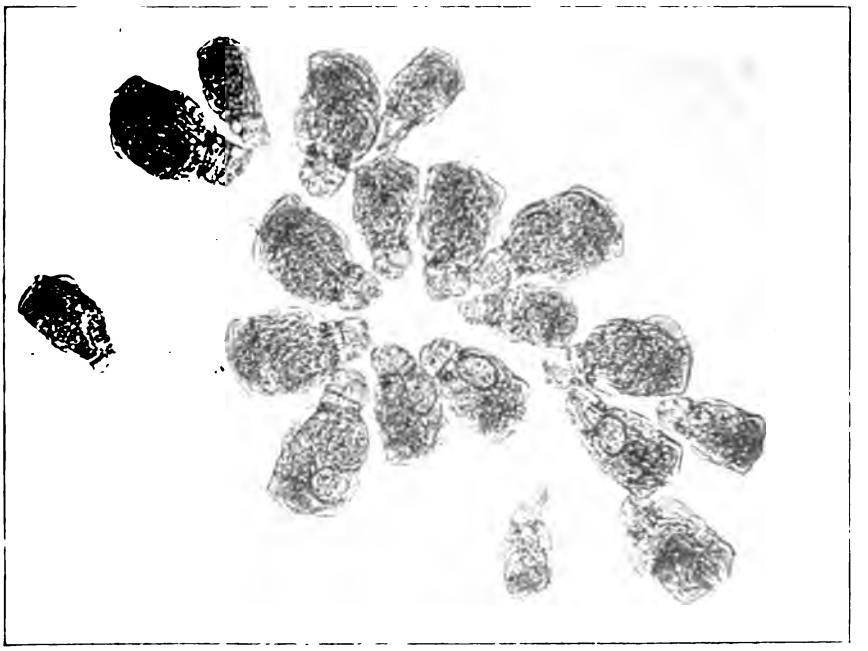


Fig. 2.

While at Whitney Lake examining the water for Dinobryon, etc., I found numerous colonies of Conochili swimming near the surface. An examination of the colonies later disclosed many Vorticellæ interspersed among the Conochili. An obscurely granular jelly invested the colonies, the foot of each Conochilus reaching to the center and exhibiting the usual contractility. In the jelly were embedded also the abortive stocks of the Vorticellæ, extending towards the center of the colony, but tapering to invisibility at a distance from the body equal to about twice its length. The half of the stalk next the body was evidently muscular, or contractile, while the inner half was very slender, losing itself in the jelly, as stated. *No sheath* whatever was discernable, and when the muscular part of the stalk was contracted the fiber merely became thickened and wrinkled in appearance, being then perhaps a little less than half the length of the body, with no tendency to a spiral arrangement. The total amount of contraction was, therefore, very slight; but the Vorticellæ exhibited the usual irritability, contracting promptly when the slide was tapped with the handle of a dissecting needle. The stalk apparently had a secure attachment somewhere in the jelly, although the end could not be located. The Vorticellæ mostly extended further out from the center than the Conochili. Several abandoned stalks were noticed scattered through the jelly, and several V. were observed in process of longitudinal division. The numbers of each genus were counted in several colonies, and were as follows: C. 6, V. 26; C. 12, V. 10; C. 12, V. 16. In general, as far as examinations were made, the Vorticellæ exceeded in number the Conochili.

These facts suggest an interesting speculation in the phylogeny of this species of Vorticella, if, indeed, it is a Vorticella. It may, of course, be more nearly related to some of the free-swimming forms. The advantages to the Vorticella are plain,—protection and economy in locomotion, etc., but it is not evident that the Conochilus derives any benefit from the association with its more humble neighbor. The entire absence of a sheath for the muscular fiber is significant, and, in connection with the remarkable reduction in the length of the latter, points to an evolutionary history of some length. A still further evolution might result in complete atrophy of the contractile fiber, for it seems to be of little or no use in its state here. It would be of great interest to find the early stages of this association.

It might be added that the body of water mentioned contains the usual variety of vegetable and animal organisms common to the water supplies throughout the state, and has been subject at times to temporary epidemics of the malodorous Uroglena volvox.

H. A. Doty.

New Haven, Conn.

A Quickly Made Glass Cell.

A square or circle of cover-glass of the desired thickness is placed upon the surface of the turn-table, together with a minute drop of water. Just enough water should be used to hold the glass firmly to the surface. If too much is used at first, the glass may be pressed down and moved about and the surplus absorbed with filter paper. When properly done, the glass is held firmly enough

to permit circles being cut upon it with a writing diamond. These are made of the size desired for the cell, and the glass then slid off the turn-table. It is rarely possible to free the circle from the ring without breaking the latter; it is best, therefore, to cut across the ring with the diamond, and then by a little gentle bending back and forth the ring is broken at the cut and teased loose from the center. The cut across the ring does not impair its efficiency as a cell, and it may be immediately cemented to the slip with hard marine glue by heat. This is an expeditious method, and furnishes a durable and handsome cell. Should the surface of the turn-table not be smooth enough for the firm attachment of the glass cover, a slip may be put on the table and the cover placed on that.

H. A. Doty.

New Haven, Conn.

Fig. 1.

Spring-Clip.

This has the advantage of extending very little beyond the boundaries of the slide itself, and permits the slide and spring to be placed in an ordinary rack box and the cover to be put on. The amount of pressure is easily regulated by bending one way or the other before application. I have found spring brass wire about 21 American gauge to furnish a satisfactory range of pressures. The photograph (Fig. 1) plainly shows the construction.

H. A. Doty.

New Haven, Conn.

The Flexibility of Diatom Shells.

While the diatoms are regarded as brittle, and rightly so, their shells often have a surprising flexibility owing to their extreme thinness. The accompanying picture (Fig. 1, p. 992) shows two valves of *Synedra capitata*, one lying flat and straight, and the other bent into a considerable curve and viewed edgewise. Many other diatoms will tolerate a good deal of bending, notably some of the Pleurosigmas.

It is probably not worth while to describe the method by which this Synedra was coaxed into its position, but it may be stated that a good mechanical finger and mechanical stage are necessary. A sparing use of the former accessory may be recommended, for more can be learned of the real shape of diatoms in an

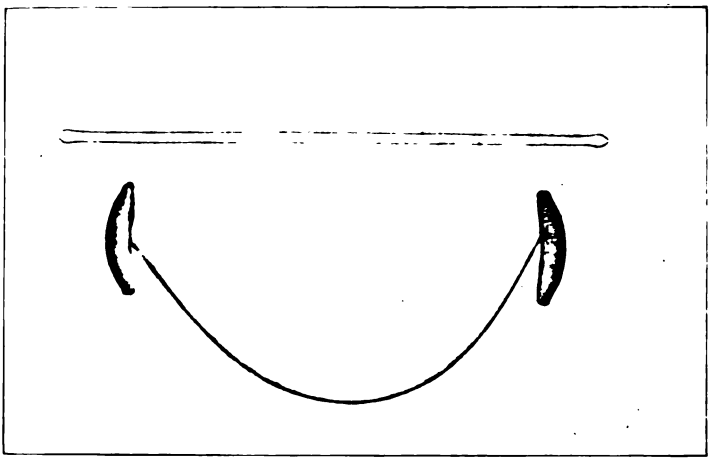


Fig. 1.

hour's use of it than by several days of ordinary examinations; but if one succumbs to its fascinations, it is apt to become a time-wasting instrument. The photograph (Fig. 2) shows my form of finger, made to my specifications by the

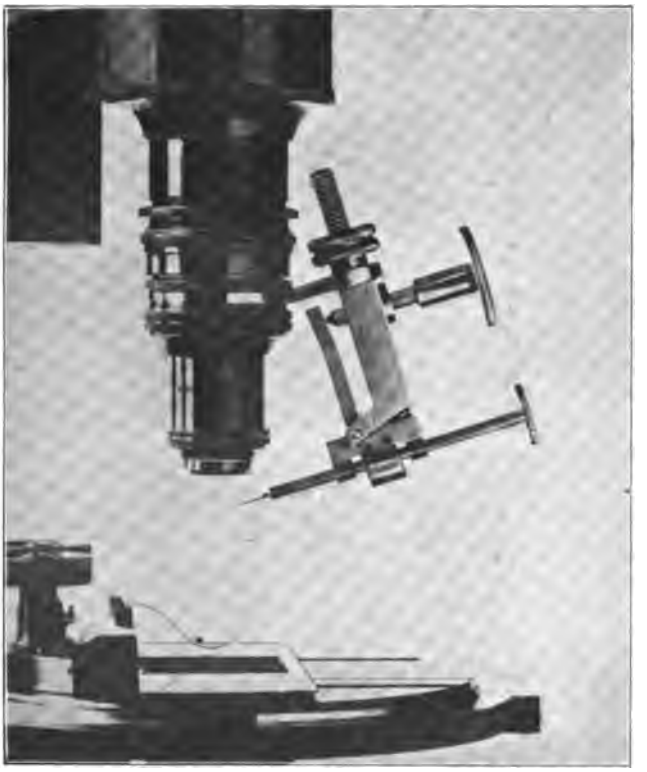


Fig. 2.

B. & L. Co. It allows the rod carrying the bristle to be instantly removed, the pin in the end of the rod being also removable, so that several sizes and forms of bristles may be employed without loss of time upon the same piece of work. Its other adjustments are so clearly shown as to need no further description.

New Haven, Conn. H. A. DOTY.

Investigations at Cold Spring Harbor.

The work at the Cold Spring Harbor Laboratory during the past summer has been most successful as regards both quantity and quality of investigations pursued.

Studies worthy of special notice are:

"Cryptogamic Studies at Cold Spring Harbor;" Dr. D. S. Johnson.

"Studies in Ecology;" Dr. Henry C. Cowles.

"Trematode Studies;" H. S. Pratt.

"Development of Squilla empusa;" Dr. C. P. Sigerfoos.

"Variation in Color Pattern Produced by Changes in Temperature and Moisture;" W. L. Tower.

"A Study of the Variations in the Number of Grooves upon the Shells of Pecten irradians (Lam.);" Frank E. Lutz.

"Statistical studies on Sand Fleas;" Mabel E. Smallwood.

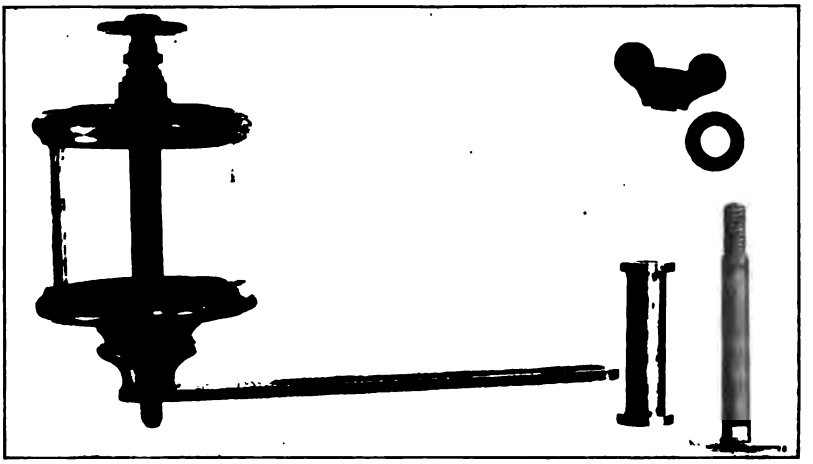
"Pedigree Mouse Breeding;" C. B. Davenport.

STAINING METHOD.—The nervous system of the Turbellaria may be differentiated by a staining fluid composed of fifty parts one per cent. picro-carmin and fifty parts two per cent. aqueous solution of eosin. This fluid is specially adapted to the *Dendrocœla*. Specimens should be hardened in alcohol, left in the stain from one-half to four days, the picrin extracted by frequently renewed seventy per cent. alcohol, followed by ninety per cent., after which it is left in absolute alcohol as long as the eosin dissolves. Sections show all the tissues well stained, and the nervous system brought out with great clearness.

Adult forms of *Distomum hepaticum* may be found in the bile-ducts of the sheep and the ova pressed out into water at a temperature of about 30° C. and left in the dark at this temperature for about fourteen days. Then bring them into the light in some place at a lower temperature, and in about an hour about seventy per cent. of the embryos will leave their egg cases and collect in numbers on the side of the dish toward the light. They swim about in the water for about twelve hours, when they sink to the bottom and die. They may be kept alive for two or three days in .6 per cent. salt solution.

Irrigating Apparatus for Celloidin Sectioning.

The use of the celloidin method of embedding certainly possesses advantages in furnishing sections to large classes of students in histology



PARTS OF MECHANICAL DEVICE FOR THE FLOODING OF MICROTOME KNIFE WITH ALCOHOL.

and pathology. The necessity of keeping the knife flooded with alcohol during microtomy adds much to the drudgery if the alcohol is supplied from a brush or pipette. The writer has found that the device to be described has proved very satisfactory in lessoning the tedium of section cutting for large classes. The essential points of the device are a modified oil cup of any convenient size such as is used in the automatic oiling of machinery, and the attachment of this cup by means of a suitable support to the sliding block which carries the microtome knife. In this way the alcohol can be dropped upon any part of the knife and in any desired amount. The extra weight of the alcohol cup upon the

ALCOHOL DROP BOTTLE ATTACHED TO MICROTOME.

knife block presents no objection. By means of the needle plunger with which the oil cup is furnished, the number of drops per minute can be regulated to a nicety, and the flow can be immediately stopped by turning down the plunger. The economy of the alcohol is perhaps another advantage of this device, as the use of an excess is prevented. P. M. HICKEY, M. D.

Detroit.

Fresh-Water Aquaria.*

The lover of nature often feels the desire to cultivate a nearer acquaintance with the living things that he sees in ponds and pools. He may dip up samples here and there, taking some water weed and a string of the jelly beads containing toads' eggs, place them in glass jars or aquaria at home, and gain further pleasure, for a few days at most, and then the whole mass becomes foul and is thrown away. His ill-success is due to the improper balance between animals and to the popular misconception that an aquarium with animal life should be uncovered so that the animals can get air to breathe; and the remedy lies in keeping the aquarium, once properly balanced, from one spring to another, so well covered that scarcely any evaporation of water can take place. To this then may be added new organisms from time to time.

None of the numerous notices on the keeping of aquaria that I have seen described permanent aquaria without changing the water; yet this is one of the most desirable features — to keep the aquarium, year in year out, for observing the interesting succession of forms, often including representatives of animal groups from Protozoa to Crustacea, with an almost equal diversity of aquatic plants.

Some of the pond scum (Algæ), drawn by light and adhering to the side of the glass, may be made to decorate the side of the aquarium with almost any pattern in green — letters, or your monogram if you choose. Some of my experience may be useful to the reader, and I gladly give it for what it may be worth.

Seeing the Algæ in my largest aquarium accumulate on the side most strongly lighted, it occurred to me that they might be made to form a definite design by regulating the light. First a stencil of paper or pasteboard was used, but as this was not permanent enough, one of my students, living next door to a tinsmith, cut out the monogram of our school and attached it to the outside of the aquarium, having previously cleaned the inside with a scraper. In a few weeks the letters "D. H. S." were sharply marked by the sun's ray-pencils and the microscopic green plants within. (See figure in JOURNAL APPLIED MICROS., July, 1899, Vol. II, No. 7.) The stencil may be removed at any time for inspection, but should be kept in position the half of each day, while the strongest light falls on the aquarium to keep the letters from being obliterated. This experiment serves to illustrate the movement of green plants towards the source of light, and has interested many of our visitors.

Such balanced aquaria also have a practical value in the schoolroom or labo-

* American Naturalist, March, 1900.

ratory; each one will have its own fauna, and may serve as a source of animalculæ — Amœbæ and other Protozoa so highly prized by the young teacher— and larger animals and plants for demonstration, experiment, or research, in more nearly their natural environment, than those kept in water changed daily. This last spring we had a nice illustration of this fact; some fairy shrimps (Branchipus) were placed in a glass jar with water and plants of their habitat, and a few were placed in one of the balanced aquaria of the same size and receiving the same lighting. Those in the first jar died in a few days (the common experience of every one who has tried to keep them in the laboratory for demonstration), while those in the aquarium lived three times longer.

In one small aquarium jar, set up over a year ago, containing mostly diatoms, Oscillaria, some water fleas, and Rotatoria, there has been a good supply of Amœbæ for class use. Another larger one, kept over two and one-half years, in which a large snail, some water weed, and smaller animals constitute the balance, furnishes sun animalcules for demonstration. The largest one, with glass plate sides, slate bottom and ends, has been kept nearly two years without change or addition of water. It is stocked with aquatic plants, Cladophora, Myriophyllum, Lemna, Wolffia, Anacharis, and many single-celled Algæ. The largest animal representative is a so-called "bull-head" (one of the species of Uranidæ), about four inches long, kept principally for the balance, and because he needs no further attention than a few earthworms every few days. In this aquarium fresh-water polyps, Polyzoa, and other interesting forms appear in their season.

In speaking of the time these aquaria have been kept, it is to be understood without changing the water but covered in such a way as to require very little or no additions of water to supply evaporation.

The aëration of the water for the breathing of animals will be readily seen to come from the oxygen given out by the plants while they feed (during photosyntax) on the carbonic acid gas given out by the animals. The only thing needing attention is the feeding of such animals as cannot find their source of food in the aquaria themselves, and this should be done so carefully that no food is left to decay.

For aquaria almost any kind of glass vessel that can be securely covered against dust and bacteria may be used — jam jars, battery jars, culture dishes, and globes for the smaller window aquaria; window glass, properly cemented into wooden frames that are kept coated with paraffin or asphalt varnish, for a medium size; and slate bottom and ends, with plate-glass sides, for the larger though more expensive ones.

In setting up the aquaria it is better to begin with water from some clean pond containing considerable plant and animal life. Fill up to within a few inches of the top with water, and then add about $\frac{1}{25}$ its bulk of plants and animals; or hydrant water may be used, adding some plants, and later the animals desired. Where there is no choice, snails and Crustacea are the most convenient for use, unless they are hostile to the organisms desired for experiment. The snails feed on the plants, giving these carbonic acid in turn for food, while the Crustacea feed mostly on the débris from other organisms.

If the animals keep near the surface, too many are probably present, and some must be removed or more plants added. When the plants become yellow they are too abundant or have not had light enough. In some cases the water becomes foul on first setting up the aquarium, and as this is one way of obtaining certain desirable results, keep it covered until the foul odor disappears, and if new plants do not appear in time, add plants and animals to suit, and it may prove to be the best aquarium you have. Marine Protozoa have been kept this way in jars brought from the seashore several years ago.

Central High School, Detroit, Mich. L. MURBACH.

Journal of Applied Microscopy.

L. B. ELLIOTT, EDITOR.

Issued Monthly from the Publication Department of the Bausch & Lomb Optical Co., Rochester, N. Y.

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The majority of our subscribers dislike to have their files broken in case they fail to remit at the expiration of their paid subscription. We therefore assume that no interruption in the series is desired, unless notice to discontinue is sent.

ONE of the questions which has absorbed a large share of the time of science teachers at their conventions during the past few years is the problem of how a uniform course of study such as will really prepare the student in the secondary school for the science work he will have in the university, will be worth his while to pursue in case he, perchance, does not enter a higher school, and which will permit the revision of many university courses as now coustituted so that the student will simply continue the work where he left it in the lower school.

The objections to this at present are at least threefold; lack of uniformity in university courses, lack of uniformity in courses of secondary schools, the contempt in which the work of lower schools is held by the university professor and the desire to impress his method from the beginning on the student.

These obstacles are, we believe, being overcome, and the tendency is toward a uniform course of study in both university and lower schools, one built upon the other and continuous with it. Before such a system can become effective the machinery by which it is to be carried out must be brought into harmony. In those branches in which the laboratory plays an important part, the equipment and apparatus employed must be of uniform amount and quality, the instructors who are to guide the student in the use of it must themselves have received the proper instruction as to its construction, care, and possibilities. It will be useless for the university to expect its freshmen to take up biological work with a knowledge of the general principles of the manipulation of the compound microscope unless the laboratories of the lower schools are provided with microscopes of similar grade, and with instructors capable of teaching the proper use of them.

There are many biological subjects now brought before high school students which the facilities at hand do not permit to be more than touched upon, and which in any event would be more properly presented to more mature minds. The student is never at a better age to be interested in and profit by the facts leading to a thorough understanding of the principles of construction and the proper use of the various instruments that will figure so conspicuously in later work. The practical gain of such knowledge will be apparent the moment such a class of students come before the university professor for the first work in the laboratory. In case the student never reaches a higher school he still has a practical knowledge and ability to use the apparatus which will be more apt to lead him to employ it in private life than would the rudiments of biologic laws he would have learned in place of it.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to
Charles J. Chamberlain, University of Chicago,
Chicago, Ill.

REVIEWS.

MacBride, Thos. H. The Slime Moulds. Rhodora. Jour. N. Eng. Bot. Club, 2: 1900.

It is remarkable that the Slime Moulds, so universal in distribution, so delicate and beautiful in structure, and with so many points of curious and biologic interest, have not been more widely collected and studied in this country. "In their life history they are unlike anything with which we elsewhere have to do. They are like moulds in that they use as food organic material; they are unlike moulds in that they are destitute of hyphæ, and in their vegetative phase present a mass of slime, apparently without organization, without form, without structure of any kind; and yet living, moving, intact, cellular, multinuclear, and in growth and development evincing all the complexity of mitotic cell-division."

Capsule Types of Myxomycetes.

They live as naked protoplasm, the form of matter which everywhere fascinates the student of biology, for the secret of life is with it. "During the last twenty-five years, in all sorts of physiological and biologic treatises, the tiny amœba has been made to play the leading rôle; but the plasmodium, that is, the vegetative, active phase of a slime mould, is worth a thousand amœbas; it exhibits vital phenomena on such a macroscopic scale, contractility, irritability, assimilation, automatism, and all the other wondrous properties, so called, of living matter are here to be seen in their most beautiful display."

Perhaps no experiment is more interesting and instructive than that performed by placing a little of the plasmodium under a bell-jar, and supplying it with fresh agaric for nutrition. The protoplasm spreads in sheets and streams until

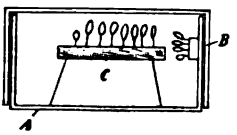
it reaches such dimensions as to line completely the glass bell-jar, and hang down in streaming pillars and columns from its summit.

Under favorable conditions, this fascinating growth continues for some time, and finally the mass transforms itself into the fruiting stage; but lack of food, or moisture, or an unfavorable change in temperature, takes away its vitality, and it presently succumbs to the assaults of a horde of real moulds and Fungi.

Although the laboratory may help us, we must go out of doors and be content to stay out of doors for a day at a time sometimes, if we would study slime moulds and know them. In moist and mossy woods, by perennial springs and streams, these things are at their best. They appear in the early summer, in June, and continue under favorable conditions until late in the fall.

To study slime moulds successfully, the care of material must begin in the field. It should be carefully removed from its place of growth and placed in small boxes, in which it may be transported with perfect safety. "Herbarium specimens are best cared for by mounting in small boxes, which may be selected of such size that a certain number will exactly fill a shallow covered tray, say one inch deep, and of the dimensions outside of standard herbarium sheets."

The accompanying figure shows a good method of mounting specimens in the small boxes. To the bottom of the box (A) is glued a bit of cork (C) upon which is fastened the bit of material carrying the slime mould. The mount should be just so high in the box that the sporangia will escape the lid when the box is closed. A smaller bit of material may be similarly attached to the box side (B) for examination by the microscope in this position. For more exact study the material must be mounted for investigation under lenses of highest magnifying power. For some species, as the Stemonitis species and the Cribrarias, it is desirable to mount the sporangia on the slide dry, in natural condition. In ordinary cases, however, other methods must be used. For temporary mounting, a weak solution of potassic hydrate will be found serviceable, to be followed by glycerin if the specimen is to be kept any length of time.



C. W. J.

Conrad, A. H. A Contribution to the Life History of Quercus. Bot. Gaz. **29**: 408–418, pl. 28–29, 1900.

This is a brief but very clear account of spermatogenesis and oögenesis in *Quercus velutina*. Material was collected at intervals of a few days from May 5th to July 7th. Picro-acetic acid was preferred as a fixing agent because it left the material less brittle than the chromic mixtures. The principal results are the following:

Stamens are already formed in the winter buds, but the sporogenous tissue is not distinguishable until spring. The carpels can be distinguished, but are more rudimentary than the stamens. The further history of the stamens presents no variations from descriptions of other angiosperms, though it might be noted that comparatively few of the microspores show a division into the generative cell and tube nucleus while still within the anther. During the first year the carpels fuse to form three loculi, each with two placental folds; one ovule grows from each fold. As the ovule develops, its nucellus shows a mass of archesporial cells, from twenty to sixty in number. Several of these cells may start to develop,

and occasionally more than one reaches the four nucleate stage of the embryo-sac, but only one reaches the fertilization stage. The polar nuclei fuse early, and after fertilization there is a copious development of endosperm which shows no tendency to form walls up to the time when the embryo is well differentiated.

C. J. C.

Rowlee, W. W., and Nichols, Susie P. The Taxonomic Value of the Staminate Flowers of some of the Oaks. Bot. Gaz. **29**: 353–356, figs. 8, 1900.

A study of the staminate flowers of eight species of oaks growing in the vicinity of Ithaca, N. Y., shows that there is enough variation to make the staminate flower valuable for taxonomic purposes. In preparing material the flowers were opened, the stamens removed, and the perianth mounted in glycerin jelly. The oaks are so difficult to determine, and keys are so unsatisfactory, that every new feature is welcome. The key for the eight species studied is given entire, in the hope that other observers, in other sections of the country, may test the value of this character.

KEY TO NATIVE OAKS, BASED ON THE STAMINATE FLOWERS.

A. Stamens six to nine.
  I. Bract persistent after anthesis, - - - - *Q. acuminata.*
  II. Bract deciduous before anthesis.
    a. Perianth deeply lobed.
      1. Lobes narrowly linear, - - - *Q. macrocarpa.*
      2. Lobes obovate or spatulate, - - - - *Q. prinus.*
    b. Perianth with shallow lobes.
      1. Perianth slightly campanulate; diameter 2-3 mm., *Q. alba.*
      2. Perianth rotate; diameter 1–2 mm., - *Q. platanoides.*
B. Stamens four or five.
  I. Midrib wanting, - - - - - - - - *Q. velutina.*
  II. Midrib present.
    a. Perianth pilose, - - - - - - - *Q. coccinea.*
    b. Perianth smooth, with lobes thinly ciliate, - - *Q. rubra.*

C. J. C.

Arnoldi, W. Beitrage zur Morphologie der Gymnospermen, III. Embryogenie von Cephalotaxus fortunei: Flora **82**: 46-63, pl. 1-3, 1900.

This third contribution to the morphology of gymnosperms deals with the embryology of *Cephalotaxus*. Taxonomists have placed this genus between *Phyllocladus* and *Ginkgo* on the one hand and *Torreya* and *Taxus* on the other. In anatomical features it resembles *Taxus*, while the structure of its ovule allies it more nearly with *Ginkgo* and the *Cycads*. It was the object of this study to determine whether embryology would throw any light upon the relationships of this interesting form.

The material was obtained from a botanical garden in Southern Russia. Alcohol was used for fixing and Zimmermann's fuchsin and iodin green for staining. The figures, many of which were drawn from photomicrographs, show that valuable material was almost ruined by crude methods.

As in many other gymnosperms, the ovules require two years for ripening.

In the first year the nucellus and integument are formed and pollination takes place; in the spring of the second year the archesporium and embryo-sac are formed; endosperm appears in May, and before the end of the month the archegonia are developed; fertilization occurs about the middle of June, and during August the embryo is fully formed.

The following are the principal results of the study:

1. The neck of the archegonium consists of two cells, as in the oldest gymnosperms.

2. The material for the growth of the egg is supplied by the nuclei of the cells immediately surrounding it and has, at first, the form of very small droplets. After these have passed into the egg they attain considerable size and complexity of structure; they serve for the nourishment of the embryo in its earliest stages.

3. The nucleus of the central cell of the archegonium divides, but does not form a ventral canal cell; the upper part of the central cell with its nucleus then becomes mucilaginous, destroys the neck cells and presses out from the egg.

4. The pollen tube contains four nuclei; the two generative nuclei are of the same size, differing in this respect from *Taxus*.

5. After the pollen tube has discharged its contents, one of the generative nuclei fuses with the egg nucleus while the other remains in the upper part of the egg, where it may divide amitotically. The fusion nucleus moves to the middle of the egg, where it divides three or four times; the daughter nuclei divide at the bottom of the archegonium and thus there arises a number of free cells, which then become arranged into tiers in much the same manner as in *Taxus*, according to Jaccard's recent description. The later stages in the development of the embryo were described long ago by Strasburger in his *Angiospermen und Gymnospermen*.

C. J. C.

Nawaschin, S. Ueber die Befruchtungs vorgänge bei einigen Dicotyledoneen (Vorläufige Mittheilung.) Ber. d. deutsch. bot. Gesell. **18**: 224-230, pl. 9, 1900.

It is less than two years since Nawaschin announced the discovery of double fertilization in *Lilium* and *Fritillaria*. Since that time his results have been confirmed by Guignard and Miss Sargant, but the double fertilization was recorded only in liliaceous forms until the present paper appeared. The peculiar spermatozoid-like generative nuclei described by Merrell for *Silphium* may have led Prof. Nawaschin to investigate fertilization in the Compositæ. He finds in *Helianthus annuus* and *Rudbeckia speciosa* spiral nuclei resembling those of *Silphium*. Fertilization in both of these forms is essentially the same as in *Lilium*, one of the male nuclei fusing with the egg nucleus and the other with the micropylar polar nucleus, the three then fusing to form the primary endosperm nucleus.

The writer also observed the double fertilization in *Delphinium elatum*. In this plant the two polar nuclei fuse some time before fertilization and the egg nucleus, after fusing with the male nucleus, undergoes a long resting period, but the second male nucleus fuses with the endosperm nucleus.

Three orchids from Java, *Phajus blumei*, *Phajus sp.* and *Arundina speciosa* were examined with results somewhat at variance with Strasburger's account of fertilization in European species. In these three species the polar nuclei do not fuse at all, but after the fertilization of the egg, three nuclei, one of which is smaller

and denser than the other two, may be seen even after the embryo has begun to develop. The smaller nucleus is believed to be the second male generative nucleus.

Prof. Nawaschin regards the fusion of the second male generative nucleus with the endosperm nucleus as a true fertilization. C. J. C.

Johnson, D. S. On the development of Saururus cernuus L. Bull. Torr. Bot. Club, **27**: 365-372, pl. 23, 1900.

Botanists have always placed *Saururus* among the lower Dicotyls on account of the naked flower and form of the carpel. Engler has recently separated it from the Piperaceæ, and has placed it, together with two other genera, in a separate family, the Saururaceæ, which he regards as the simplest of the Dicotyls after *Casuarina*. It was the object of this work to find out whether Engler's view would be supported by embryological details.

The floral development and the structure of the mature embryo-sac are essentially the same as in other Angiosperms. There is a single archesporial cell which divides to form a tapetal cell and a sporogenous cell; the latter divides, and of the two resulting cells the one nearest the micropyle divides again while the other at once develops into the fertile macrospore. The oosphere and synergids have definite walls, the polar nuclei fuse to form an endosperm nucleus, and the antipodals, which are quite normal at first, soon disorganize. After the first division of the endosperm nucleus a wall is formed between the daughter nuclei, and the endosperm is formed from the upper cell, the nucleus of the other daughter cell undergoing no further division, but its nucleus becomes very large. The egg does not divide until endosperm consists of a dozen or more cells.

The writer believes that his results indicate that *Saururus* is not among the higher Dicotyls, although he fails to find in its development any essentially primitive characters, the immediate formation of walls in the endosperm being quite frequent in Dicotyls, and the formation of endosperm from only one of the daughter nuclei, resulting from the first division of the primary endosperm nucleus, not rare; and further, the slightly developed embryo with a small amount of endosperm in the ripe seed being found in distantly related forms.

These results are particularly interesting, in view of the recent divergent accounts of Prof. Johnson and Prof. Campbell upon *Peperomia*, a genus placed quite near Saururus. C. J. C.

Celakovski, L. J. Die Vermehrung der Sporangien von Ginkgo biloba L. Oesterreich, Bot. Zeitschrift, **50**: 229-241, 276-283, 337-341, 1900.

This somewhat lengthy paper is largely occupied by descriptions of abnormal flowers of Ginkgo and theories as to their evidence in regard to the relationships of this peculiar genus. The ovulate leaf of Ginkgo, which is much reduced, is stalked like the foliage leaves and the stalk of the ovulate leaf is homologous with the stalk, or filament, of the stamen. The primitive type of ovulate leaf is stalked, as in Equisetum, and where the ovulate leaf is sessile the stalk has been reduced. The reappearance of the stalk is an atavistic phenomenon.

Normally, Ginkgo has two pollen sacs, but the writer found many sporophylls with three, and some with four. The normal pollen sacs come from the back of

a rudimentary "crista," which corresponds to the shield of Taxus. The writer believes that in Taxus the primitive radial sporophyll, with sporangia on the under side has survived, and that abnormal sporophylls of Ginkgo show a transition between the radial and bilaterial types. The abnormal sporophylls show a remarkable resemblance to the sporophylls of the Coniferæ, especially the Cupressineæ, the sporophylls of which are derived from forms like Taxus. As the shield becomes more like a foliage leaf, the sporangia disappear from the upper side and the organ becomes bilateral instead of radial.

Prof. Celakovski concludes that if Taxaceæ and Pinaceæ be two families, then the Ginkgoaceæ must be a third, and that these three should be retained under the group, Coniferæ, the latter coördinate with Cycadaceæ and Gnetaceæ.

C. J. C.

CYTOLOGY, EMBRYOLOGY, AND MICROSCOPICAL METHODS.

AGNES M. CLAYPOLE.

Separates of papers and books on animal biology should be sent for review to
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CURRENT LITERATURE.

Creighton, C. Chick's Amnion — Allantois. Jour. of Anat. and Physiol. Normal Path. **33**: 527–44, pl. 2, 1899.

Dr. Creighton speaks of a peculiar relation between certain branches and the capillary loops of the umbilical vein in the inner lamina of the chick's allantois, where it is adherent or fused with the amnion. He has evidence to show that the "lymph," which is used for the absorption of the yolk in the later period of incubation, comes from the *liquor amnii* in part by direct transudation from the amnion sac where it presses on the pole of the yolk-sac, and in part by a system of lymphatic sheaths of the allantoic vessels, filled with lymph from the adherent amnion. Yolk is brought here from the yolk-sac in a roundabout way, along with much of the albumen from the albumen-sac.

Rhumbler, L. Physics of Cell Life. Entwickelungsmechanik, **9**: 32–100, pl. 1, 1899. See also Am. Naturalist, **34**: 546, 1900.

In investigating the physical aspects of cell life the author has turned his attention to the distribution of pigment in eggs and young larvæ. He accepts the view that protoplasm has a foam structure, and endeavors to explain the distribution of pigment as due to physical stress and strain. Fischel, succeeding in staining living Echinoderm eggs with neutral red, found during division that minute colored granules collected about the nucleus, these in the spindle stage becoming dumbbell-shaped. This part Rhumbler explains as follows: during division the nucleus absorbs water from the surrounding foam, thus the alveoli lessen in size, and large bodies, as yolk granules, are squeezed away from the region of pressure. On the other hand, very small bodies, like the stained granules, may cling to the alveolar lamellæ, and

by the condensation of these appear to collect about the nucleus. In like manner the pigmented sperm-track in the frog's egg may arise from the physical stress produced by the passage of the sperm through the foam. It tends to pull the foam framework along with it, making a tension behind it, and an outflow of the more liquid contents of the alveoli results, accompanied by a shrinkage of the lamellæ to which the pigment granules cling. In general it is the author's opinion that pigment plays no active part in developing eggs, merely collecting passively in regions of increased pressure and condensation.

Garnier, Charles. Structure of Serous Gland Cells. Jour. Anat. Physiol. **36**: 22–98, 3 pls, 1900.

The author has studied the minute structure of the serous gland cells of vertebrates in order to study the processes of secretion, and the part played by ergastoplasm in this form of cell activity. The paper is most comprehensive, including the author's observations; also the observations and conclusions of others, an historical sketch of the subject and a full bibliography. In the following words an ideal sketch of the history of a gland cell is given: The originally nearly homogeneous cytoplasm becomes differentiated, displaying filaments that are at first acidophil. Simultaneously the nucleus increases in size, is subject to various changes, eventually yielding caryoplasmic substances for the use of the ergastoplastic filaments, which ultimately become basophil. Reconstruction of the nucleus follows, and the basophil filaments give rise to the secretion. In the differentiation of the secretory granules the ergastoplastic filaments disappear, the secretion is excreted, and the cytoplasm is ready to repeat the process. This series of changes represents, in the opinion of the author, the most general condition, but cannot be followed in all its stages in any particular case. The ergastoplasm represents a substance intermediate between those of plasmatic and those of cytoplasmic origin, and serves to transform for the cytoplasm the substances given to it by the nucleus. Some observers believe the nucleus to take a more active share in secretion than is alloted to it in this scheme.

Dean, Bashford. Development of Bdellostoma storeti. Festshrift C. von Kuppfer, Jena, 221–76, 12 pls. and 5 figs. 25, 1899.

An account is given in this paper of the development of this myxinoid from the egg to the time of hatching. Spawning in *Bdellostoma* is described, and the question of protandrous hermaphroditism in Myxine is discussed and held to be unproved. Descriptions of the ovum of Bdellostoma, its fertilization, segmentation, its blastula, gastrula, early and later embryos, and newly hatched young, are given in full, also notes on the integument, skeleton, nervous system, viscera, etc. The general conclusions are as follows: The great dissimilarity in the developmental plan of the Hyperotretes and Hyperoartes indicates a division in the cyclostome phylum, the yolk filled, few eggs of the myxinoids contrasting strongly with the many holoblastic eggs of lampreys. In Bdellostoma a highly specialized method of gastrulation exists. As usual, the mass of yolk modifies the mode of the appearance and the physiological relations of the embryo. In origin, the periblastic-like nutritive layer is a parallel to that in selachians, also in teleosts, although specialization does not proceed far enough to form a definite

germ ring, as in the case of the latter group. The two types of cyclostomes stand, perhaps, most widely apart in the processes of gastrulation. The lumen of the central nervous system arises in the myxinoids by the enfolding of the medullary plate, a part of great significance. That the adverse conditions of yolk and restricting membranes fail in preventing the occurrence of this character, gives it clearly great palingenetic value. In embryo bdellostomes the great brain length is also significant. No good evidence of degeneration can be found in the auditory and optic organs, nor is there much support for the belief that the pineal eye was primitive in the Craniota, nor any marked evidence for the existence of end organs in a series as a distinct lateral line. The head structures differ markedly from those of the lamprey. By the flattening of the head in early stages the stomodæal region is modified, making it impossible to say at present to what point in the mouth the primitive ectoderm extends. Evidence goes to show that the hypophysis has a palæostomal nature (von Kuppfer's view). That the posterior part is distinctly paired, calls to mind Dohrn's early work on the homology of this structure with gill slits. No structures comparable directly with visceral arches occur in any stage. The skeletal elements of the hind part of the head probably arise as neomorphs in relation to the barbel and tongue muscles. There is no hint of paired fins. The myxinoids have a simpler excretory system than that of the lampreys. This conclusion is greatly supported by the discovery that a series of segmented tubules, probably pronephric, occurs practically the whole length of the body of the embryo. From these facts it is fairly concluded that the myxinoids are not very degenerate. Morphologically the author emphasizes the fact that the branchiomery does not correspond with the myomery. He also suggests that the vertebrate brain represents a complex of colonies of nerve-cells, drawn together from various body regions to a physiologically convenient position by having similar functions, the determinant in position being this physiological convenience, which then becomes the criterion of the homology of parts.

CURRENT BACTERIOLOGICAL LITERATURE.

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Separates of papers and books on bacteriology should be sent for review to H. W. Conn, Wesleyan University, Middletown, Conn.

Smith, R. Greig. Double Staining of Spores and Bacilli. The spore-bearing material is distributed in normal salt solution in a small test tube; an equal volume of carbol-fuchsin is added, and the mixture placed in boiling water for fifteen minutes. A loopful is then withdrawn, spread over a cover-glass, dried, and fixed in a flame. The bacilli are decolorized in one and one-half per cent. (by volume) of alcoholic hydrochloric acid, washed in water, and counterstained in methylen blue. Even the most refractory spores are stained deep red, the bacilli blue. C. W. J.

Wright, James H. A Simple Method of Anærobic Cultivation in Fluid Media. Jour. Bost. Soc. Med. Sc., June, 1900.

The adjoining figures represent a simple apparatus used successfully by the author of this article in the cultivation of the tetanus bacillus. The apparatus consists of a simple arrangement of glass and rubber tubes, enclosed in an ordinary test-tube with a plug of cotton inserted in its mouth, as in the ordinary culture tube.

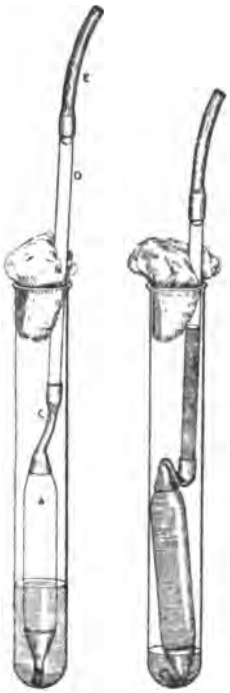

Fig. 1. Fig. 2

When it is desired to make an anærobic culture, the culture fluid is put into the test-tube, and inoculated in the usual way. By suction, the fluid is drawn up into the system of tubes, to a level above C, after which the rubber tube E is compressed between the fingers and the tube D pushed downward into the test-tube in such manner as to fold the rubber tubes D and C, as seen in Fig. 2, thus rendering the fluid in A perfectly air-tight.

Advantages of this method are, briefly:

1. Simplicity of apparatus.

2. Any number of pieces of the apparatus may be kept on hand sterilized, ready for use.

3. It offers a means of determining whether a given bacterium grows better under ærobic or anærobic conditions, by comparison of the growth inside the tube with that outside.

4. The user may form some idea of the purity or impurity of the culture, for in strict anærobes the lack of bacterial growth in the fluid outside in the test-tube is a good sign of the absence of contamination with ærobic bacteria. C. W. J.

Brayton, Dr. A. W. Several Unusual Cases of Skin Diseases Observed in Indianapolis.

The first case reported was similar to the one by Schenck, reviewed on page 526, Vol. II, of this journal. There was a series of abscesses containing a watery, semi-gelatinous substance which was given microscopical examination with negative results, but no cultures were made. He supposes the case to be due to sporotrichal infection. The other cases were blastomycetic dermatitis, herpes gangrenosus, xanthoma tuberosum, icthyosis simplex, tinea favosa, keratodermia palmaris and plantaris through four generations, idiopathic multiple pigmented sarcoma cutis, dermatitis herpetiformis of Duhring, leucokeratosis buccalis, and xeroderma pigmentosum—Kaposis disease.

In the case of blastomycetic dermatitis, cultures were made upon wort gelatin and the yeast plant isolated. A guinea-pig inoculated with the culture showed symptoms of the disease. The yeast plant was also isolated from a second similar case. The yeast infection is like inoculated peripheral tuberculosis in the tendency not to extend itself rapidly to adjacent tissues nor to internal organs.

Brayton emphasizes the importance of preserving excised diseased tissues for microscopic study, a practice especially valuable in the case of rare diseases of doubtful ithology. He cites a solution of two per cent. formaldehyde as serving for a preservative. E. M. B.

Nobbe and Hiltner. Künstliche Ueberfahrung der Knollchen-bakterien von Erbsen in solche von Bohnen. Cent. f Bac. u Par. II, **6**: 449, 1890.

Since the discovery that the root tubercles of the leguminous plants are produced by bacteria, there has been a considerable difference of opinion as to whether the bacteria found in the tubercles of different species of legumes are the same, or whether each kind of legume has its own peculiar species of bacterium. This question has been investigated by the authors in a series of experiments upon beans and peas. The general result of their work is that, while the bacteria-producing tubercles upon these two types of legumes are somewhat different from each other, they are probably varieties of the same organism. The variety of *Bacterium radicicola*, which produces tubercles on the pea, when inoculated into soil in which beans are growing, is capable of producing on the beans small tubercles which have no power of fixing nitrogen. When, however, in later experiments, similar beans are inoculated with the bacteria from these on the beans, they prove to have adapted themselves to the new plants and produce tubercles with fixation of nitrogen, although smaller in amount than is normal for bacteria of this species of legume. At the same time, further experiment shows that they have lost, in a measure, their power of producing nitrogen fixation in the pea. This proves that they have adapted themselves to the new conditions, and have actually changed their characters. H. W. C.

Radzievsky. Ueber Infection. Cent. f. Bac. u. Par. I, **28**: 161, 1900. Beitrag zur Kentniss des Bacterium Coli. Zeit. f. Hyg. u. Infec. **34**: 369, 1900.

These two papers detail experiments upon the important subject of the methods by which pathogenic bacteria produce their injurious effects in the animal organism. It has been generally assumed, in recent years, that as the bacteria grow, they produce, either as secretions or as biproducts of decomposition, certain toxic poisons which act directly upon the animal to produce the pathological symptoms. It has been held by some that in reality the toxic products are rather the result of death and destruction of the bacteria, than of their active growth. In a long series of experiments, described more in detail in the second of the above papers, Radzievsky has endeavored to investigate this question. His most important conclusions are: (1) that a fatal infectious disease is to be divided into two stages. In the first stage the pathological effects are the results of the active multiplication of the bacteria. In the second stage, however, there begins a destruction of the micro-organisms, and the pathological effects upon the animal are produced by the toxic bodies arising from their destruction. (2). The animal that is invaded develops the power of killing and destroying the invading organisms. This power is due to materials present in the body fluids which are derived primarily from the living cells. The destruction of the bacteria takes place partly within the leucocytes, but chiefly outside of the cell bodies in the body fluids. H. W. C.

Backhaus and Appel. Ueber aseptische Milchgewinnung. Berichte des Landwirtschaftlichen. Instituts der Universität Könisburg, 1900.

The authors describe a series of experiments designed to determine to what extent milk is contaminated with bacteria at the time of milking, and how far this contamination can be avoided. They find, as others have found, that

milk from sound cows is sterile. They find further—contrary to general belief—that bacteria do not grow within the milk duct to any extent. This they think is proved by the fact that the common forms of milk bacteria soon disappear if inoculated into the ducts. They conclude that by great care in milking nearly all of the bacterial contamination may be avoided, but that the care requisite is so great that its application is hardly practical. The exercise of ordinary care may, however, reduce the number greatly, and confine them to a few harmless species. The three most common dairy bacteria they find to be *B. guntheri*, *B. lactis aerogenes*, and *B. acidi lactici*. H. W. C.

Chester. I. Studies in Systematic Bacteriology. II. Description of New Species of Soil Bacteria. Eleventh Annual Report of Del. Col. Agri. Expt. Sta. 1898–99.

Chester has previously made some valuable contributions to this difficult topic, and now adds a third paper. There is no subject where there is greater need of more systematic methods than in the study of the characterization and classification of species. In the first article he gives many useful suggestions as to methods of descriptions and classifications, and in the second there is a careful description of nine species of bacteria isolated by him from the soil of Delaware. The latter paper is illustrated by two plates. H. W. C.

Conn. Classification of Dairy Bacteria. Annual Report of Storr's Agri. Expt. Sta. 1899.

The paper by Conn is a description of about one hundred varieties of bacteria isolated by him from milk products during the last eight years. A considerable number of these species are new. A series of tables in which characters are entered by the sign of + or — is devised for rapid use in identification of species. The common dairy species are found to be *A. acidi lactici* (identical with *B. guntheri*) and *B. lactis aerogenes*.

H. W. C.

Committee on Public Health, of the Med. Soc. of the Dist. of Columbia. Report on Rabies. Bul. No. 25 of the Bureau of Animal Industry.

This report, while containing the results of no experiments, is of exceptional interest as indicating the present attitude of our most cautious scientific students in regard to the question of hydrophobia. The result of their painstaking investigation of all information obtainable has been very decided. They emphatically assert that rabies is a distinct communicable disease produced by a specific virus. With no less emphasis do they insist that Pasteur's method of inoculation against hydrophobia is a positive success, and one of the crowning achievements of his life. H. W. C.

Grimbert et Legros. De l'indentite du bacillus lactis aerogenes et de pneumo-bacille de Friedlander.

There is no subject in bacteriology of more philosophic interest than the origin of pathogenic bacteria. For a long time it has been suspected that many, if not all, of our pathogenic bacteria have been derived originally from simple saprophytes. The close relation between *B. coli* and *B. typhosus* has long been a subject of suggestion and experiment. Our authors, in this article, have endeavored to determine whether the common *B. lactis aerogenes*, a universal inhabitant of ordinary milk, is not identical with

the closely allied pneumonia bacillus of Friedlander. Obtaining four different cultures of this common lactic organism, they institute a careful comparison between these and the organism of Friedlander. This comparison includes studies of the general biological and morphological characters which are ordinarily used for the characterization of bacteria, the study of this inaction upon nitrogenous matters, such as peptone, albumen, milk and nitrates, and the study of their action upon carbohydrates. In every respect the organisms agree, and the authors conclude that they are identical. H. W. C.

Remy. Contribution a l'etude de la fievre typhöide et de son bacille. Ann. de l'Inst. Past. **14**: 555, 1900.

Hankin. On the Detection of the Bacillus typhi abdominalis in water and other substances. Cent. f. Bac. u. Par. I, **26**: 554, 1899.

Sternberg, C. S. Zur Verwerthbarkeit der Agglutination für die Diagnose der Typhusbacillen. Zeit. f. Hyg. u. Infec. **34**: 349, 1900.

The vexed question of the separation of the typhoid bacillus from its close ally, *Bacillus coli*, is perpetually subject to new investigation and experiment. In the three articles here listed various phases of this general subject have been investigated. The first one describes a special culture fluid made of pure chemicals, which the author believes is a sure means of differentiating the typhoid bacillus from all others. The second paper describes a method of isolating the typhoid bacillus from water, based upon the use of the Parietti culture fluid and the subsequent agglutination test. The third paper makes careful experiments upon the value of the agglutination test. In these experiments it is shown that four cultures of water bacteria, allied to the typhoid bacteria but clearly distinct from it, answer to the agglutination test as readily as does the typhoid bacillus itself. The author is of the opinion that agglutination is insufficient as a diagnostic test, and the only way that the typhoid bacillus can be positively differentiated from its allies is by a complete study of *all* its biological characters; a conclusion which makes its demonstration in water a matter of most extreme difficulty.

H. W. C.

Marx and Wolthe. Morphologische Untersuchungen zur Biologie der Bakterien. Cent. f. Bac. u. Par. I, **28**: 1, 1900.

This article makes an especial study of the peculiar little bodies found in bacteria by Babes and Ernst, and known as the Babes-Ernst bodies. A long series of studies has shown the authors that they are extremely common among bacteria, since they are found in the coccus forms as well as in the rod forms. Their presence in any particular species of bacteria at any time depends upon conditions. They are most abundant in vigorous cells. They disappear after long cultivation on artificial media, but will reappear again when the bacteria are placed under natural conditions, especially when they are forced to live in contact with other species of bacteria (symbiosis). The authors are convinced that these bodies are not nuclei in any true sense, but are special condensations of coloring matter (chromatin). Although not real nuclei, these bodies, like nuclei, have a distinct relation to the transmission of specific characters from generation to generation. They appear in abundance when conditions are somewhat adverse, and there is, therefore, need of a modification of the species. In general they correspond to Weissman's *germ plasm*, while the rest of the bacteria body corresponds to his *nutritive plasm*.

H. W. C.

NEWS AND NOTES.

CLEPSINE.—The ova are large and easily prepared, and are favorable subjects for study. Embryos left in Merkel's fluid for one to two hours will have the germ layers and cell groups forming the central nervous system, nephridia, etc., well differentiated. Clepsine has eight rows of "neuroblasts," the two medias of which give rise to the nerve chain. The ganglionic chain develops from before backward; the nerve-collar and supra-œsophageal ganglia are formed from cells lying beneath the epidermis, and not from a thickening of the epidermis itself.

CHICK EMBRYOS.—To prepare the living embryo for study under the microscope the egg should be opened in normal salt solution, and a rim of paper gummed on the yolk around the embryonic area. This will adhere to the vitelline membrane in a few minutes, when the blastoderm may be cut around outside the paper ring and the whole removed to a watch-glass or a slide.

RABL'S PICRO-SUBLIMATE.—Chick embryos of three or more days' development may be fixed by leaving for twelve hours in a solution consisting of one part saturated aqueous corrosive sublimate, one part saturated aqueous solution of picric acid, and two parts of distilled water. After fixation, wash for two hours and place in alcohol.

TO MOUNT YOUNG CHICK EMBRYOS IN TOTO.—Open the egg in warm .5 per cent. salt solution and remove the blastoderm from the yolk membrane. The blastoderm is then freed from yolk that may adhere by shaking it about in the fluid with pincers, after which it is floated out on a glass slide and treated with a few drops of one-half per cent. osmic acid solution for two or three minutes, washed with distilled water and stained with picro-carmin, after which the slide is covered with Müller's fluid and left over night. Dehydrate and mount. After being floated into position on the slide, the edges of the blastoderm should be allowed to dry to the slide and all the fluids should be dropped on the middle of the disc so that it will be kept flat.

TOTO MOUNT OF BLASTODERM (*Whitn.*) (534).—Break shell at broad end and cut away shell over upper third or half. Remove as much white as possible and place rest of egg with shell in enough ten per cent. HNO_3 to cover it. Remove coagulated white from blastoderm with brush and leave egg in acid thirty minutes. Cut around blastoderm with scissors and float into watch-glass right side up and flat, pull off vitelline membrane with dissecting forceps and wash yolk off with pipette. Wash in water several times. Stain deeply with carmin or hæmatoxylin, decolorize with equal parts of water and glycerin, a few drops of one per cent. H Cl, wash, treat thirty minutes with two parts alcohol (seventy per cent.), water one part, glycerin one part, then seventy per cent., then absolute. Clear in clove-oil and mount.

MANIPULATION OF CHICK EMBRYOS.—During the earliest stages of development, up to twenty-four hours of incubation, the yolk and the blastodisc are hard to separate and should be fixed together. The egg should be broken at the

broad end and the shell picked off bit by bit with forceps until the blastodisc is exposed. Open the egg in normal salt solution (.75 per cent.), lift it up to bring the blastodisc above the surface of the liquid and drop the fixing solution on it with a pipette. In a few minutes it will be hard enough to remove from the yolk, which is done by cutting around with scissors and floating the blastodisc out into a watch-glass, where the vitelline membrane is shaken and pulled off with the forceps, after which the hardening fluid is added. If preferred, enough of the fixing fluid may be taken to cover the egg, and the blastodisc fixed *in situ* for fifteen or twenty minutes before removing from the yolk. Ten per cent. acid makes a good fixing agent, and facilitates the separation of the blastodisc. In about ten minutes the specimen should be placed in a two per cent. solution of alum.

VIALLETOUS METHOD.—The egg is opened in salt solution and the blastodisc removed to a glass plate, where it is treated with a one per cent. solution of silver nitrate, washed, and left in seventy per cent. alcohol for six to twelve hours in the dark, after which it is stained in borax carmin, dehydrated, and mounted in dammar.

SEA-URCHIN.—Delage made experiments on the fertilization of sea-urchin egg. Spermatozoa entered a perfect egg, a fragment which possessed a nucleus, and a fragment without any nucleus. All three developed to the gastrula stage, the embryo from the enucleated portion of an egg being small, and having the enteric and blastocoelic cavities nearly obliterated, and this portion was also slowest in development, while the nucleated fragment was intermediate between this and the nucleated egg.—*Am. Nat.*, March, '99, p. 256.

Loeb finds that unfertilized sea-urchin eggs will form normal gastrulæ and plutei if placed in sea water to which magnesium chloride has been added in the proportion of 5000 (10/8 n Mg Cl) to 5000 cc. sea water. Eggs were kept in this solution for about two hours and then changed to normal sea water. Fewer eggs developed, and development was slower than under normal conditions.

Prof. Morgan placed sea-urchin eggs in sea water to which two per cent. or less of sodium or magnesium chloride has been added, and returned them to common salt water after a short time. Even unfertilized ova, so treated, underwent an abnormal form of cleavage into many cells, although the process never went far enough for the formation of larvæ. Sections showed the presence of an abnormal number of stars and centrosomes in abnormal positions, and the chromosomes were apparently distributed through the egg by the action of these stars. Cleavage occurred about the chromosomes as centers.

Hertwig, O. Ueber den Einfluss der Temperatur auf die Entwicklung von Rana fusca und Rana esculenta. Arch. f. Mikr. Anat. Jan. '98. **51**: 319–377.

The Hertwigs experimented upon frog, chick, and sea-urchin ova to determine exposure to heat and cold, and the limits beyond which there would be no development. It is well known that temperature plays an important rôle in development, heat accelerating and cold retarding growth within certain limits beyond which death results. Unfertilized sea-urchin eggs may be kept for

several hours at a temperature of 2° or 3° C. without losing their power to develop. Normally, one spermatozoon enters the ovum. When an egg has been cooled one-half hour several spermatozoa enter, and after this comes a stage when no fertilization occurs. When heated for five minutes up to 31° fertilization is normal, beyond this there is over-fertilization, and from 39° to 47° C. there is no fertilization. In eggs cooled for fifteen to thirty minutes, to 1° to 4° below zero, the whole achromatic part of the nuclear figure degenerated, while the chromatic part underwent few, if any, changes. When brought to room temperature again, the spindles, etc., reformed in about ten minutes.

The zoöspores of *Chlamydomonas pulvisculus* are strongly attracted by light. The influence of different parts of the spectrum varies, yellow having no effect, while the blue, green, and red portions are active.

Mechanism of Fertilization. Arch. f. Physiol. 85: 219–23. Roy. Mic., 86, 43. Antherozoids in Cryptogams attracted to surfaces move in circles. Spores of ferns germinate in from three to five days. *Onoclea struthiopteris* and *sensibilis* used. Spore lengthens and divides transversely, forming a small transparent one which becomes the first root hair and a larger one with chlorophyll. The larger one then divides into a row of cells, and if grown in water often does not go beyond this stage, or it may be sown on fine, moist soil. The roots of fern embryos are always strongly negatively heliotropic. Monocotyledons respond quickest for growth of pollen grains, and *Tradescantia* is most serviceable. The tubes begin to grow in a few minutes. For quick response saturated solution of cane sugar is best. Place pollen grain on cover and the drop of solution so it will be near the object. It grows best from flowers that have been open some time.

ASCARIS MEGALOCEPHALA.—For *toto* mounts, the ova are treated with a mixture of five volumes of absolute alcohol and one volume of glacial acetic acid for twenty-four hours, followed by staining for forty-eight hours in a solution of Bismark brown (solution saturated while hot, acid filtered after cooling, and mixed with one-third of its volume of glycerin). Such preparations retain their color for several months. For sectioning, fix in the same solution a drop of ten per cent. platinum chloride to every two or three cc. This hardens the ova better for sectioning. After a day or two bring into absolute alcohol, then chloroform, chloroform paraffin, soft and hard paraffin. It is easier to handle the ova if they are left connected with pieces of the uterus.

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Methods for the Preparation and Study of Microscopic Organisms.

During the past year a number of experiments along this line were performed in the biological laboratory of the University of Montana. Many of the experiments were unsatisfactory, and the results poor. Yet that was to be expected. It is hoped later to continue these experiments with other organisms and a more extensive list of reagents.

The experiments were with the more active animalculæ. The specimens were small, and naturally the results were determined accurately with difficulty.

A process which would serve well for one class of objects would be inapplicable to others. The ordinary reference book will give information as to best stains for nuclei, protoplasm, etc.; but the processes when given in detail apply to higher organisms; and the application of a process often causes failure on the part of the student.

It is very interesting to study microscopic life in its natural condition and environment; sluggish forms can easily be studied by simply mounting them in the media in which they live, but for the more active forms, as most Infusoria, some means must be provided to restrict their movements.

There are many agents recommended for inhibiting their movements. There is a process given by Jensen [48], which would seem to give satisfaction:—Make a solution of 3 grms. of gelatin in 100 cc. of ordinary water by the aid of heat. This is a jelly at the normal temperature, and is to be mixed with a drop of water containing the organisms. It is very clear and would not be likely to affect the structure of the organism.

In most cases a mesh of cotton fiber is effectual; the organism will live indefinitely, not being affected by any unnatural media.

Many of the microscopic animals cannot be examined under a microscope without subdivision or previous preparation; either on account of their size or great transparency, their parts must be differentiated.

It is not always necessary to fix the organism in order to differentiate the parts. It may be stained during life by adding to the water in which it is confined, weak solutions of hæmatoxylin and dahlia, nigrosin, methylen blue, iodin green, and other tar colors. The nucleus may be stained in the living organism by dahlia and malachite green.

Examination in a colored medium, in which the organisms do not stain, but show up on a colored background, is helpful to show certain details of formation not easily discerned in any colorless medium.

Microscopic life can be studied with greater ease and more satisfaction if one has mounted specimens to work with. Then, it is not always possible to obtain microscopic organisms when they are wanted. It is therefore advisable to have mounted specimens which, when prepared well, bring out in detail the differentiated parts in a way that would be impossible in a living organism.

The first step in the preparation of specimens is the fixing of the organism. As there may be some uncertainty as to the meaning of the word "fixing," a paragraph by Lee [48], stating what is implied by it, is given:

"There are two things implied by the word 'fixing'; first, the rapid killing of the element, so it may not have time to change the form it had during life; and secondly, the hardening of it to such a degree as may enable it to resist without further change of form the action of the reagents with which it may be subsequently treated."

The action of fixing agents consists in the coagulation of certain of the constituents of the animalculæ. Without good fixation it is impossible to get good differentiation with the stains, or preparation in any way.

The fixatives which have been used for microscopic life, and some others which, having been used for delicate, transparent and contractile forms, can in all probability be used for microscopic life, are the following:

Corrosive Sublimate.—A cold or hot concentrated solution applied cold or boiling.

Osmic Acid.—This is a good fixing agent, in that it leaves the specimens unchanged as to structure and form; but it does not give good results, as the specimen becomes blackened even with the greatest care. Microscopic organisms treated with it swell and become very opaque. In short, the ordinary fixation it gives does not pay for the care required to produce it. Osmic acid if used should be followed by carmin or hæmatoxylin.

Chromic Acid.—An aqueous solution of .1 per cent. to 1 per cent. is used. Chromic acid is considered excellent for soft gelatinous specimens, and necessitates washing in running water. It is best to use some analin stain after it. This would be impracticable for minute organisms.

Chromo-formic Acid.

Chromic Acid and Spirit.—A mixture of 1-6 per cent. chromic acid and 1 per cent. methylated spirit is used for all structures. Hæmatoxylin is used for staining.

Alcohol.—Absolute or a very weak mixture must be used. It is a good fixing agent.

Flemming's Solution.—The formula for this is:

Chromic acid,	1 per cent.	25 cc.
Osmic acid,	1 per cent.	10 cc.
Acetic acid,	99 per cent.	5 cc.
Distilled Water,		60 cc.

This is usually followed by hæmatoxylin.

Perenyi's Solution.—

Nitric acid,	10 per cent.	40 cc.
Chromic acid,	½ per cent.	30 cc.
Alcohol,	90 per cent.	30 cc.

Any alcoholic stain may be combined with this solution.

Picro-chromic Acid.

Chromic Acid and Platinic Chloride.—This is a very delicate fixative.

Permanganate of Potash.

Chloride of Platinum ($Pt\ Cl_4$).

Platino-aceto-osmic Mixture.—The after treatment and staining should be the same as for objects treated with Flemming's solution.

Erlicki's Solution.—

Bichromate of potash,	2.5 parts.
Sulphate of copper,	1.0 part.
Water,	100.0 parts.

Bichromate of Ammonia.—A 5 per cent. solution is used.

Acetate of Lead.

Pyridin.

Brass' Formula.—

Chromic acid,	1 part.
Acetic acid,	1 "
Water,	400 parts.

The specimen is to be washed out with water.

Brass also employed picro-sulphuric acid; the specimen should be washed out with boiling water and then placed in diluted ammonia to reduce it to normal size. The ammonia was neutralized by diluted acid and the preparation with borax carmin.

Palladium Chloride.—This is good for Infusoria.

Gold Chloride.—This is a good fixing agent, but unstable.

Perchloride of Iron.—This is recommended by Fol for ciliated objects, and is to be followed by the stain, Pyrogallal.

Acetic Alcohol.

Formic Acid.

Picric Acid.—This should be employed in the form of a strong solution. The specimen should be washed with alcohol.

Kleinenberg's Picro (See *Sulphuric Acid*).—This is not recommended for delicate organisms.

Alcohol.—It may be used in a very weak mixture or absolute. Two parts water to one part of 20 per cent. alcohol is a good proportion, and the specimen may be stained with picro carmin, alum carmin, or methyl green.

Acidulated Alcohol [43].

Chloride and Acetate of Copper.—This is a very moderate and delicate fixative.

Potassium Iodin.—This acts like osmic acid without the blackening incident to the latter. When not otherwise stated, the fixing agent is to be washed out with 60 per cent. or 70 per cent. alcohol, usually 70 per cent.

After corrosive sublimate, osmic or chromic acid, washing should be done with water. After picric acid in any form, the specimen must be washed with alcohol; for the reason that picric acid does not enter into combination with the tissues and is entirely removed by water, leaving the specimen soft.

Chromic acid and its salts, osmic acid, chlorides of palladium, of gold and and of iron, are reagents that combine chemically with the tissues, and necessitate special after treatment; chromic acid has such penetrating power that it would be almost impossible to remove it from objects before it had ruined them. The chromic objects also become brownish green. The chromic acid hardened materials are best stained with bluest eosin (rose bengal).

The quantity of fixing agent employed should be many times the volume of the objects to be fixed. The strength of the fixing agent must be altered for different species. It is best if convenient to put the organisms in the fixing solution by means of a pipette instead of pouring the solution over them.

A number of the fixing agents given above have been tried to determine which of itself, without regard to the after treatment, was the best. The following are the experiments performed with a few of the fixing agents:

Perenyi's Solution, washed out with 70 per cent. alcohol; the nucleus appeared lighter than the rest of the organism. The cilia were contracted and the specimens, though somewhat shrunken and opaque, were not distorted.

Osmic Acid.—The specimens were dark brown when first mounted, and after a few days became very black. They were not distorted in the least.

Brass' Formula.—This fixative was washed out with water. The specimens were not shrunken, but on the contrary were swollen. The cilia were not contracted and the nucleus was clearly defined.

Flemming's Solution.—The specimen was washed out with 70 per cent. alcohol. The nucleus was very clear and the cilia were not contracted. The specimens were transparent and somewhat swollen.

Corrosive Sublimate.—The sublimate was washed out with water. The specimens were more transparent than in the above experiments and did not become granular. The nucleus was not so well defined.

Corrosive Sublimate plus Acetic Acid.—The results were the same as for corrosive sublimate. The specimens in the last two cases contained crystals of sublimate after washing a half-hour in water which was constantly changed.

To make sure that all the sublimate is removed the specimen should be washed in alcohol into which a solution of iodin has been added, drop by drop, until the alcohol remains colored. Specimens killed with boiling saturated sublimate should be allowed to harden for some minutes in chromic acid of one-half per cent. and then transferred to alcohol.

James F. Porter [42], in his article on Gregarines, says that he invariably obtained the best results by killing in a concentrated aqueous solution of corrosive sublimate and staining in Kleinenberg's hæmatoxylin. He also says that the aqueous stains were, as a rule, unsatisfactory although he succeeded very well with Mayer's aqueous hæmatoxylin.

It is generally acknowledged that aqueous stains are the best. Alcoholic stains do not give a stain equal in precision and delicacy to the aqueous, but for

delicate organisms the change from alcohol to water produces very injurious results.

The stains are divided into three groups according to their chemical composition; the carmins, the hæmatoxylins, and the anilins.

The certainty and ease with which many of micro-organisms are stained by the anilins has made them very useful in bacteriological work. The anilins are again divided into the basic and acid anilin dyes. The basic,—methyl green, bismark brown, safranin, methylen blue, etc., are used for staining nuclei.

Safranin is a famous stain for karyokinesis.

The acid anilin dyes,—eosin, fuchsin, orange green, etc., are used for staining the protoplasm of cells. A process which is recommended to give good results is to harden in Müller's fluid and stain in safranin and anilin blue.

The nucleus is stained red and the protoplasm and cilia blue. The reactions on Protozoa are the same as those on cell nuclei. An acid solution of methyl green allows of the readiest and best demonstrations of the presence and form of the nuclei and the nucleoli. Weak solutions of alum, potash and borax serve to demonstrate the striations of the cuticle and the insertion of the cilia of Infusoria.

Flemming's safranin solution is used for the chromatic network of the nucleus.

A few drops of nigrosin, 1 per cent. to 2 per cent. in water, to a watch glass full of water stains filamentous Algæ or Fungi in one to three hours. The stain keeps well in either glycerin or balsam, but it is difficult to get these subjects into balsam without more or less shrinking.

Nitrate of silver is uncontrollable in its action, and therefore does not make either a good fixing agent or stain. Chromic salts are not considered successful.

An article by Julia B. Platt [20], on the *Specific Gravity of Spirostomium, Paramœcium, and the Tadpole in Relation to the Problem of Geotaxis*, gives an insight into the effect which the density of culture media may have on microscopic life. Geotaxis is the relation of the force of gravity to the action of organisms.

She says, "It is known that some Algæ and Infusoria tend to collect near the surface of the water in which they live. A number of experiments have shown that this tendency cannot be ascribed altogether to the attraction of the light. It is therefore affirmed that these organisms react to the force of gravity. This reaction or negative geotaxis is attributed by Schmary to the direct influence of gravity on the organism, which incites motion in the opposite direction; while Jensen attributes the reaction to the indirect influence of gravity on the organism by means of the difference in hydrostatic pressure at different depths.

"The experiments of these authors seem to show that the possibly eccentric position of the center of gravity in the organisms cannot be regarded as a factor determining the direction of motion.

"In order to test this problem of geotaxis, solutions of varying density in which the Infusoria would still live were used. To try this it was necessary to find some solution in which the animal, either dead or paralyzed, remained suspended without rising or falling; and also a solution in which Infusoria would live.

"Solutions of salt, sugar and glucose of sufficient density to be serviceable will

kill the Infusoria. Gelatin was not satisfactory, since even weak solutions tend to become stiff when cold. I found a solution of gum arabic admirably adapted to my purpose.

"Paramœcia and Spirostoma live for hours in solutions heavier than their specific gravity, not only surviving, but also multiplying when kept for days or weeks in solutions of less strength.

"My conclusions regarding reaction to gravity are purely negative with regard to Paramœcia.

"To obtain the specific gravity of Paramœcia, I tried to paralyze them with ether, quinine, and nicotine, but invariably killed the Paramœcia, which in dying went to pieces. I added a few drops of acetic acid to the water containing the Infusoria. As acetic acid is said to swell protoplasm, I also killed Paramœcia by the fumes of osmic acid. Both of these reagents caused the specimens to change their shape somewhat in dying, by becoming wider and shorter. Their form, however, remained symmetrical in both cases, and seemed neither enlarged nor distorted.

"The Paramœcia found in the culture of our laboratory and in the pools of water did not show geotactic tendencies.

"Small tadpoles that are negatively geotactic do not become positively geotactic when placed in solutions heavier than their own specific gravity, as one would expect were their upward motion in direct response to the action of gravity on the organism as a whole."

It is often advantageous for active organisms to use some agent to render them less active, that is, to stupefy them before using the fixing agent. Those fixing agents commonly used are chloroform, ether, muriate of cocaine, hydroxylamin, chloride of magnesium and chloral hydrate.

Chloroform can simply be poured over the surface of the water containing the organisms, and thus slowly diffused through the water; or by means of a pipette it may be forced into the water, thus becoming effective more quickly. With such organisms as Vorticellæ the former method would be the best. Ether is used in the same way.

Muriate of Cocaine.—A 1 per cent. solution of muriate of cocaine (in water) which is added gradually to a small quantity of water (5 cc.) in which the animals are contained, is the best proportion. When the fixing agent is added the cocaine is thrown down in the form of a white precipitate.

Hydroxylamin for paralyzing is generally successful, but reduces many fixing agents. A 1 per cent. solution should be made and then diluted when wanted, and the organism placed *in* it.

Chloride of Magnesium.—A 33 per cent. solution is introduced into the vessel containing the specimen until it contains a 1 per cent. solution.

Chloral hydrate in a weak solution is a narcotizing agent, and in a strong solution, a killing agent. A few crystals are placed in the water in which the organisms are. It dissolves slowly, first stupefying and then killing.

Heat is also employed as a fixing agent. Place the animalcule in a drop of water on a glass slip and heat it in a flame until the water steams, then put the animalcule in 70 per cent. alcohol. This method was tried and found wanting. Two preparations were made using this method of fixing.

Hæmatococci were fixed in this manner, stained with eosin, washed in alcohol and cleared with zylol, and then mounted in balsam. The results were not satisfactory. The specimens were shrunken, and the stain did not differentiate well; this, no doubt, was due to the fixative.

Paramœcia were killed and fixed in a flame and placed in borax carmin. After they had remained in the stain for four hours they were examined and found to be hardly stained. They were then left in eight hours longer and were then stained too deeply. The specimens were shrunken but not distorted.

The writer used only Brass' formula, Flemming's solution, Perenyi's solution, alcohol, chloral hydrate, corrosive sublimate, and corrosive sublimate plus acetic acid, considering them as likely to give the best results in the hands of an inexperienced person.

The experiments performed are as follows:

Daphnia, Ehrlich's Stain was used. It differentiated the muscular tissue very well, but did not bring out the digestive or reproductive systems.

Daphnia.—Dahlia stain did not differentiate the different tissues. It does not give satisfactory results, staining too deeply or not at all. It is diffuse and must be taken out of the 95 per cent. alcohol almost immediately or it will all be washed out.

Daphnia.—Killed with corrosive sublimate plus acetic acid and stained with eosin and methylen blue; the result was very bad.

Daphnia.—Borax carmin gave fair results.

Daphnia.—Blue Black was not very satisfactory.

Dipterous Larvæ.—Eosin stained the muscular tissue best, and altogether was good.

Dipterous Larvæ.—Dahlia stained the muscular tissue intensely.

Dipterous Larvæ.—Chloral Hydrate.—The specimens were placed in a solution of chloral hydrate for a half-hour; then washed with water and placed in absolute alcohol; then stained with eosin, washed in alcohol and mounted. The result was ordinary. The muscular tissue was well brought out.

Hæmatococcus.—Corrosive sublimate was used for killing; washed out with water. It was followed by borax carmin; this was washed out with 70 per cent. alcohol; the specimen was then dehydrated, cleared in zylol, and mounted in balsam. The preparation was good.

Paramœcium.—These were killed with Flemming's solution, washed in 70 per cent. alcohol, and stained with safranin and anilin blue. The result was not good.

Paramœcium.—Perenyi's Solution.—The specimen was washed in 70 per cent. alcohol, stained with borax carmin, washed in 70 per cent. alcohol, dehydrated, stained with picric acid, washed in 90 per cent. alcohol, dehydrated with absolute alcohol, and mounted in balsam. Results were good. The nucleus was stained red and yellow, but the cilia did not show up.

Paramœcium.—Perenyi's Solution.—The specimen was washed with 70 per cent. alcohol, then with acidulated alcohol, stained with safranin and hæmatoxylin, washed with 80 per cent. alcohol, then placed in absolute, and mounted in balsam. Results fair.

Then was tried washing with absolute alcohol after staining with safranin, but the results were not nearly so good as those first washed with 80 per cent. alcohol, when the nucleus was stained with the hæmatoxylin and the rest of the cell with safranin, although the results were not as satisfactory as might have been expected.

Paramœcium.—Staining with fuchsin after killing with Perenyi's solution is very unsatisfactory. Violent currents are produced and the organisms easily become brittle while they are being dehydrated.

Hæmatococcus.—Perenyi's Solution.—The specimen was washed in 70 per cent. alcohol, stained with carmin magenta (1 to 3 parts of 70 per cent. alcohol). This is a slow stain and the results are quite ordinary. The specimens were left in a good condition, but the parts were not well differentiated.

Paramœcium.—Perenyi's Solution.—The specimen was washed out with 70 per cent. alcohol, stained with alum hæmatoxylin, washed and dehydrated with alcohol, cleared with olive oil and mounted in balsam. The specimens were good, but did not keep; due no doubt to incomplete dehydration.

Paramœcium —Perenyi's Solution.—Specimen was washed with water, stained with borax carmin, dehydrated, and cleared with zylol. The result was not so good as with acid fuchsin-picric acid. The nucleus was not well differentiated from the protoplasm. The specimens stained too deeply.

Hæmatococcus.—Perenyi's Solution.—The specimens were stained with borax carmin. They were shrunken, but the parts quite well differentiated. The nucleus stained bright pink.

Vorticella.—Perenyi's Solution.—The specimens were washed with water, stained with acid fuchsin-picric acid. They were in an expanded condition and stained very well.

Hæmatococcus.—Perenyi's Solution.—The specimens were washed with water, stained with fuchsin acid-picro acid, dehydrated with alcohol, cleared with zylol, and mounted in balsam. The chlorophyll was stained reddish brown, the cell wall violet, the protoplasm pink, and the nucleus very dark.

Paramœcium.—Treated the same as the Hæmatococcus above. The protoplasm was stained pink, the granular protoplasm reddish brown, and the nucleus a very dark brown. They were much shrunken; this was probably due to dehydrating, as the fixing fluid did not shink them. The cilia could not be seen. The specimens became brittle when placed in zylol.

Dipterous Larvæ.—Brass' Formula.—The specimen was washed with water, stained with fuchsin, washed with alcohol, dehydrated, cleared with clove oil, and mounted in balsam.

With some specimens, after killing, the stain was poured in the killing fluid. The results were not good, the specimens were soft after remaining 24 hours in the solution. They were afterwards hardened, but were not satisfactory.

Hæmatococcus.—Brass' Formula.—The specimens were placed in the stain immediately after being taken out of the solution. The fuchsin was washed out with 70 per cent. alcohol, and cleared in zylol. The cell wall was stained brown, the protoplasm pink, and the nucleus a deep pink.

Great care must be exercised so the specimens will not become hard, which they easily do, in dehydrating. This method was not considered good.

Paramœcium.—Brass' Formula.—The specimens were stained with borax carmin. The stain produced good results, but the specimens were hard and brittle, breaking up. This might have been due to dehydrating, but it occurred in no other case.

Paramœcium.—Brass' Formula.—Specimens were stained with fuchsin and carmin. Carmin was the more brilliant stain. Care should be taken not to over-stain with carmin.

Paramœcium.—Brass' Formula.—The specimens were washed with water, stained with carbolic fuchsin, washed with water, dehydrated, and mounted. The preparation was good.

The following are some experiments with culture media:

Paramœcia placed in a 95 per cent. mixture of Pasteur's solution and water were dead in five minutes. Those placed in 80 per cent. lived about seven minutes. Those placed in 70 per cent. became sluggish in 15 minutes and in 20 minutes ceased to show signs of life. An 80 per cent. mixture of Pasteur's solution is a good killing agent. Paramœcia placed in 60 per cent. lived one-half hour; in 50 per cent., lived one hour and were much more opaque than those killed in the 80 per cent. or even 70 per cent. mixture. Those in 40 per cent. lived two hours, in 30 per cent. two and one-half hours, 20 per cent. three hours, and in 10 per cent. one day. Those in the 5 per cent. mixture lived two days and were very much distorted. Those in the 4 per cent. and 3 per cent. mixture lived for three or four days, while one or two of those placed in the 2 per cent. and 1 per cent. mixture lived for a week or more.

Small Infusoria live and multiply rapidly in the last per cents, but the larger species do not; they may live in 2 per cent. and 1 per cent. mixture, but do not multiply. For bacteria 5 per cent. or 4 per cent. is best.

Zylol was not successful as a clearing agent; clove oil was much more satisfactory.

In dehydrating, if absolute alcohol cannot be immediately removed from the specimens, it is best to omit that step and place the specimens immediately in the clearing agent after they are treated with 95 per cent. alcohol. The clearing agent should never be omitted. The writer mounted some specimens after having treated them with 95 per cent. alcohol, without using a clearing agent. They were some of the best that had been mounted, but after a few days it was found that they were spoiled, a mist having collected around the specimens.

The student in preparing slides should watch the changes that have taken place after the use of every reagent, or he will never be able to tell where the trouble lies, if the results are not good.

One usually finds this direction given for removing the surplus water from the animalculæ: "Wait until the organisms settle to the bottom, then remove the surplus water with a fine pipette." The best way is to dip a couple of threads over the side of the watch glass containing the small organisms, and in this way siphon the water off, or have such an abundance of material that the loss of half of it will not matter.

The experiments with Pasteur's solution shows of what value it is as a culture media for some species. The organisms grew and multiplied the most rapidly in the water they were found in and to which a small amount of sugar was added.

It was not found best to expose a culture to the direct light of the window, but to keep it in a darker place.

The stains should all be very much diluted, excepting some like borax carmin that are *very* slow stains.

As a general rule, microscopists mount their specimens in gelatin. Thin chloroform balsam has been found very satisfactory.

There are many methods given for cleaning slides and cover glasses. The simplest and best method is to keep the cover glasses in alcohol well acidulated with hydrochloric acid and use the same to wash the slides, drying them with a Chinese napkin.

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Practical Metallography.

Among the many branches of investigation which have developed so remarkably during the last few years, and which have been and are largely dependent upon the microscope, is that of practical metallography. The interest along this line is increasing rapidly and new methods and apparatus for its pursuit are eagerly sought. Mr. J. E. Stead, after extensive practice in the metallurgical laboratory, has recently contributed to the *Metallographist* a paper on methods of cutting, polishing, etching, and photographing metal sections, which in his hands have proved successful.

In preliminary preparation of specimens it is advisable, though not really necessary, to obtain all the metal specimens in the form of little plates about three-eighths to one-half inch in diameter and one-tenth inch in thickness. However, as only one plane surface is required for examination, it does not matter how irregular the other portion is. The face chosen for study is ground down on an emery wheel till it is flat, then polished with a series of emery papers and polishing powder. Various mechanical devices are in use for this process of polishing, in each of which the essential part is to have the polishing agent attached to a rapidly revolving block. After the grinding on the emery wheel, the specimen is applied to No. 0 emery paper, and kept in *one* position until all the coarse marks have disappeared and the emery scratches are all in one direction. The specimen is then turned 90° and polished till again the scratches are in one direction, but at right angles to those first made. This treatment is repeated with emery papers Nos. 00 and 000.

The next step is to apply the specimen to a smooth black cloth upon which has been rubbed about one grain of diamantine polishing powder, after which the final touch is given with chamois leather and fine gold rouge.

For very fine structures parchment or fine kid leather may be used. In making the "polish attack" of Osmond, parchment with sulphate of lime and liquorice root solution is used. Cementite, pearlyte, martensite, troostite, and what Osmond calls sorbite are clearly developed by this method.

After the metal is satisfactorily polished, it is subjected to a process of etching. Besides the "polish attack" method, a second method of etching steel is by a tincture of iodin of the following strength:

Iodin	1.25 grains	100 cc.
Iodide of potassium . .	1.25 "	
Water	1.25 "	
Alcohol to make up 100 cc.		

The polished specimen is placed on a plate and one drop per square centimeter is allowed to cover it. It is left there until the iodin color is gone. The specimen is washed in water, then in alcohol, and finally dried in a blast of hot air. If, on examination, it is found that the first application has not sufficiently developed the structure, the iodin treatment is repeated.

Etching with dilute nitric acid is often recommended; the specimen is immersed in a vessel containing a 0.10 per cent. nitric acid (1.42 sp. gr.) in water, and is retained there until the structure is developed sufficiently clear. After removing from the acid it should be well washed by running water, immersed in lime water, rewashed in water, then in alcohol, and finally dried with hot air. In the absence of much phosphorus and arsenic this gives good results. Osmond recommends twenty per cent. solution of nitric acid for rapidly developing the crystalline or granular structure of steels. The specimen is immersed in the acid for one to ten seconds, or even longer, then removed, washed, and examined.

Prof. Behrens and Prof. Martens have used, with great success, the simple process of heating the steel and other specimens until they take oxidation tints. This seems to be the only method by which phosphides and carbides of iron can be distinguished from each other when associated in iron or steel.

The specimens are now ready for mounting. When quite flat they may be mounted upon glass slips, with Canada balsam or wax; but as it is rarely that the two sides are parallel, it is necessary to provide some means of mounting so as to have the polished surface perfectly parallel with the glass slide on which it is mounted. A simple method of securing this end consists in placing the polished face of the section on a piece of plate glass and putting over it a short brass cylinder accurately turned, of such depth that the back of the specimen does not stand above the cylinder. A piece of plastic wax is stuck upon the center of a glass microscope slide and this is then pressed upon the section till the glass slide comes in contact with the brass ring. The specimen adheres to the wax and the mounting is complete.

If it is desired to preserve the specimen, cover it with a solution of paraffin wax dissolved in benzole; the benzole slowly evaporates, leaving a thin protective coating of wax, which prevents rusting and which may be dissolved off by wiping it with a clean linen rag moistened with benzole, when the specimen is required for re-examination. To temporarily hold the specimen in position, a glass slide, on which is cemented a short length of brass tube, may be used. This is nearly filled with sea or silver sand; the "object" placed face upward on the sand and a piece of glass plate pressed upon it till the glass meets the walls of the brass cylinder. The glass is then removed, leaving the specimen bedded in the sand with its polished surface parallel with the bed of the stage.

When a cover-glass is admissible, it is possible to cover the polished surface in the usual way with Canada balsam.

As regards microscope accessories, it is only necessary to mention those parts

of the microscope outfit which have been specially designed for illuminating opaque objects. The systems of illumination may be divided into two main classes:

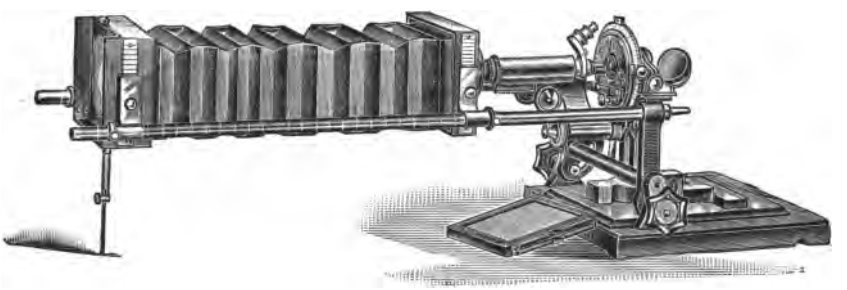
a. For illuminating by light thrown on the object by reflectors fixed below the object-glass; only admissible with low power objectives when there is ample distance between the object-glass and the object.

b. For illuminating objects when using higher-power objectives than about one-half inch focal length, mirrors and prisms placed above the object-glass are necessary.

Of the reflectors for low powers, the combination known as the Sorby-Beck reflector for oblique and vertical illumination has given very satisfactory results. In this combination the horizontal rays of light falling on the silvered parabola are reflected at various angles upon the object placed below, and if the object is a perfectly flat surface, the whole of the light will be thrown off and none will enter the object-glass; hence a flat surface cannot be seen on looking through the microscope,—it appears quite dark.

The parabola side reflector on this account is most useful in determining which part of the surface is horizontal and which broken up. It is useful also when one constituent is in relief, for as the light falls on one side of the projecting portion, it brightly illuminates it, leaving the other side in shade. The vertical illuminating mirror of Sorby, when swung over the object, partly eclipses the object-glass, but the horizontal rays of light falling on the mirror reflect vertically upon the object, and these are again reflected into the microscope.

Of the reflectors for high-power objectives, vertical illumination is a requisite characteristic. A simple form is that in which the illuminator is placed inside of a special adapter, which is screwed into the microscope tube above the object-glass. Light is admitted at the side of the adapter through an opening which is capable of adjustment by a suitable diaphragm. A more satisfactory arrangement is that in which the illuminator forms a part of the objective itself, a prism being mounted between the lens combinations. A brilliant light is absolutely



necessary, particularly when metal objects are to be photographed. In the absence of electricity a Welsbach gas lamp or an acetylene jet will answer well. A bull's-eye condenser should be placed between the light and the reflector.

In photographing these, as well as other microscopic objects, two systems of adjusting the camera are used: First, the microscope is inclined so that the tube is horizontal and the eye-piece is fitted into the front of the camera, which

is also placed in a horizontal position; secondly, both microscope and camera are placed in a vertical position. The latter system has such predominating advantages in its favor that its use is fast becoming universal.

An apparatus capable of adjustment to either position is shown in the accompanying figure. It also embodies another useful feature: one of the guide-posts is graduated, which permits the operator to compile with little difficulty a table of valuations for the objectives used; correlating the graduations with the diameters magnified.

Cleaning Desmids.

While the technique of cleaning diatoms forms the subject of innumerable papers and articles in books, I have never seen any method described for separating desmids from the mass of dirt and flocculent matter with which they commonly occur mixed. Yet from many gatherings desmids may be obtained in a state of absolute or nearly absolute purity without a tithe of the time and trouble involved in the cleaning of the majority of diatom gatherings.

The method to be described is particularly applicable to material obtained from mountain bogs containing submerged plants of *Sphagnum*, among which specimens of the genera *Micrasterias*, *Euastrum*, *Closterium*, *Penium*, and others abound. To collect desmids from this source a good plan is to squeeze the *Sphagnum* into a wide-mouthed bottle. But the majority of desmid gatherings appear amenable to the same method of cleaning.

The apparatus required consists of one or two shallow porcelain saucers or photographic dishes, an old pomatum pot being useful among the number, and a tapered glass tube with rubber cap, for which purpose the "filler" of a stylographic or fountain pen answers admirably. A gauze strainer of a coffee pot is useful for straining out any large pieces of dirt, the stuff left behind being examined for filamentous desmids.

The strained material is run into one of the porcelain dishes, and after a short interval—not more than half a minute—the dish is inclined to one side, a gentle rocking motion being given at the same time. If there are any desmids in the gathering they will be seen to collect in a *bright green line or patch* at the edge of the receding water, when they may be readily picked up with the pen-filler in a state of almost purity. On working the water round the edge of the dish, the desmids may be drawn into green patches in almost any desired part of the vessel, and one lot after another picked up till there are none left worth troubling about.

As the desmids are removed I transfer them to the pomatum pot, where a drop of Zenker's fixative suffices to fix them. A repetition of the rocking process enables the desmids to be once more collected and taken up in the pen-filler, while, if any flocculent matter was picked up with the desmids in the first separation, this may often be left behind with a considerable proportion of the fixative. The desmids are now transferred to another dish containing clear water and deposited in a patch in the water near the edge of the dish. By repeating the rocking process, the fixative is washed away, and by a little skill in the rock-

ing any foreign matter not previously removed can be separated from the desmids. The desmids are transferred to a fresh dish of clean water by again using the pen-filler, and a repetition of the process removes all residual traces of the fixative. If the desmids are to be stained, the same method may be used for washing away the stain.

This method of washing involves less loss of specimens than the ordinary method by decantation, provided that care is taken to deposit the desmids in each fresh dish of water as close together as possible; for the few desmids that are not picked up with the pen-filler in the first attempt, are easily collected and picked up subsequently. And the whole process from beginning to end takes but half an hour, or, at most, an hour, so that the fixative is removed before it has had time to injure the color of the specimens.

The only foreign bodies mixed with the desmids at the end of the process are diatoms, which will, like the desmids, have their cell contents preserved by the fixative, and will be mounted with them in the natural state, and the locicæ of rhizopods, including the pretty pear-shaped *Difflugiæ*, which also form not uninteresting additions to the slides. It appears possible to partially separate the desmids from the rhizopods either in the rocking process, where the desmids are recognizable in green patches and the rhizopods appear as brown specks, or by shaking in a little water in a test tube, when the rhizopods sink more readily than the desmids.

If much foreign matter (e. g. peat) is mixed with the original gatherings, the whole may be left in a wide-mouthed bottle in the light for a day or two, when the desmids will collect on the top of the sediment, where they will increase and multiply. The surface layer containing the desmids may be drawn off with a syphon and cleaned as before. Even in poor material it is often possible, by the rocking process, to collect with the aid of the pen-filler sufficient desmids to mount one or two slides. A somewhat similar rocking process is useful for separating Foraminifera from sand, but the rocking must be a little more violent, and the sand is left behind, unlike the flocculent matter in the desmid gatherings, which is swept forward by the water. Moreover, the Foraminifera are not easily distinguished by the naked eye, like the desmids with their conspicuous yellow color.

Fig. 1.

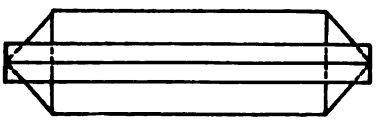
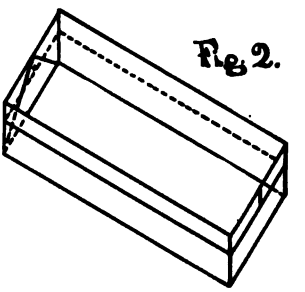


Fig. 2.



To mount the desmids I take a small piece, say 1½ x 1 in. to 1 x ¾ in. of parchment paper, such as is used for packing tobacco, and fold it into the form shown in Fig. 1, which opens out into a little box (Fig. 2). The water with the desmids is placed in the box, which is floated on glycerin. In two days the water will have diffused into the glycerin, and sufficient glycerin to penetrate the

desmids will have passed through the parchment into the box. The desmids are now ready for mounting in the glycerin, and they have undergone no contraction.

Some desmids, notably those of the genus *Closterium*, have an objectionable habit of adhering to the bottom of the dish and then floating on the water, but this tendency to float gives rise to similar difficulties when they are washed by decantation. As species of this genus increase and multiply rapidly by self-division, it is usually possible to start with sufficient material to allow of a small loss by floatation.

In some pools of running water by the roadside just below the Goat Hotel last July, I found green patches, which turned out, on examination, to consist of myriads of the beautiful *Micrasterias denticulata*. These grew with amazing rapidity when transferred to fresh water, and required little or no cleaning. Some of the residual material was thrown into a wash basin of water, and even in this large volume of water it was easy to collect the desmids into lines and patches by tilting the basin.

G. H. Bryan, Sc. D.

On the Enumeration of Nucleated Red Blood Corpuscles.

In hematological work it is often desirable to know the numerical proportion, or the number per cubic millimeter, in which nucleated red corpuscles are present, both as an index of their frequency and for comparison in different stages of the same case. The method which I employ is not, so far as I am aware, in general use, and may therefore be worthy of note. My method is carried out incidentally to the routine count of red and white corpuscles and the differential count of leucocytes. In making the differential count, the number of normoblasts and megaloblasts seen is determined and noted, along with the number of the different varieties of leucocytes. Then, knowing the number of nucleated red cells corresponding to a given number of leucocytes, and knowing the number of leucocytes in a cubic millimeter (or the proportion of leucocytes to red cells), the number of normoblasts and megaloblasts to the cubic millimeter (or their proportion to the normal red cells) can be readily calculated.

Thus, supposing that in a differential count m megaloblasts and n normoblasts are seen along with o leucocytes, and that the count of leucocytes shows that the latter are present in the number of c to the cubic millimeter, the number of megaloblasts and normoblasts in the cubic millimeter would be $\frac{c\,m}{o}$ and $\frac{c\,n}{o}$ respectively. Or, if the numerical proportion of the white to the red corpuscles is 1 to r, the numerical proportion of megaloblasts to the normal red corpuscles would be 1 to $\frac{o\,r}{m}$, while there would be 1 normoblast to $\frac{o\,r}{n}$ normal red cells.

To take a concrete example, if 80 normoblasts are counted along with 800 leucocytes in a differential count, and the number of leucocytes in a cubic millimeter is 10,000, the number of normoblasts to the cubic millimeter of blood would be 1,000. If the proportion of white to red corpuscles is 1 to 200, there would be about 1 normoblast for every 2000 normal red cells.

J. B. Nichols, M. D.

Washington, D. C.

Journal of Applied Microscopy.

L. B. ELLIOTT, EDITOR.

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NOWHERE more than in the biological sciences is it necessary for the student or teacher to come in close touch with the every-day factors of life in order to have at hand for intelligent use every facility for the rational interpretation of the phenomena which come before him, and for experimental demonstration. It is not uncommon to hear specialists express the utmost indifference to all outside the pale of the circumscribed area chosen for their particular work, and it is not surprising that the deductions of such workers should be lacking in breadth of view and out of harmony with other conditions which a more general knowledge would have shown.

The president of one of our progressive universities inquired, when examining an exhibit of scientific apparatus recently, "What is that instrument?" pointing to a compound microscope. His specialty is biblical literature, yet we cannot but think that his opinion as to the interpretation of the results of biological investigation as applied to his chosen subject would be of more value if he had a more intimate acquaintance with scientific matters.

That there is in many directions a tendency on the part of specialists to mingle with those not of their class is illustrated in the exhibits of a scientific character at the Royal Photographic Societies' Exhibit, London. The major part consisted, of course, of pictorial subjects, and one would, in America at least, never expect to find such a display as *Nature* describes as follows: "There are several contributions of photomicrographs, the series by Mr. E. M. Nelson showing the diatoms exhibited by the Royal Microscopical Society. The natural history and biological photographs of all kinds are too numerous to mention in detail. As notable illustrations of the value of a series of photographs illustrating biological changes, the sixteen lantern slides by Mr. Martin F. Woodward from his photomicrographs, showing the fertilization and segmentation of the egg of *Ascaris megalocephala*, and a frame of photographs by Mr. Edgar Scummel showing the different stages in the growth of *Nastirtium*, will repay careful study. The automatic recording of the variations of scientific instruments, spectroscopic work, surveying, mining, engineering, the production of metal reliefs, are a few of the subjects that occur to us."

The death of many societies and the dry rot which is gradually undermining most of our scientific organizations of a general nature is due, in a large measure, to the exclusiveness of specialists. The specialist, as at present constituted, is without question a great and necessary factor in the world's progress, but how much better for the science for which he labors, and for the community in general, if he could be induced to apply the results of his work to practical purposes and to diffuse his discoveries through ordinary channels.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to Charles J. Chamberlain, University of Chicago, Chicago, Ill.

REVIEWS.

Arnoldi, W. Die Entwickelung des Endosperms bei *Sequoia* sempervirens. Beiträge zur Morphologie einiger Gymnospermen. I. Bulletin des Naturalistes de Moscou, Nos. 2 and 3, 1899.

A short review of this paper in the Bot. Centralblatt (84: 132, 1900) indicates that *Sequoia* differs from other conifers in the development of its endosperm. According to this review, there arises in the lower portion of the embryo-sac a relatively small-celled vegetative tissue, while in the upper part there are large vacuoles, as in other conifers. The upper part then forms vegetative tissue and produces the archegonia. In this separation into two somewhat well-defined regions, *Sequoia* resembles *Gnetum*, as recently described by Lotsy, but it must be remembered that in *Gnetum* a tissue is formed only in the lower part, the nuclei not being separated by walls in the upper part. C. J. C.

Harper, R. A. Cell and Nuclear Division in Fuligo Varians. Bot. Gaz. 30: 217–251, pl. 14, 1900.

In his recent work on Fuligo, Professor Harper has contributed much to our scanty knowledge of this interesting but much neglected group. In his study of cell and nuclear division in *Fuligo varians* the author finds that spore formation is preceded by numerous cleavage furrows. These furrows, which are very narrow and sharp in some cases and quite widely open in others, usually arise first on the external surface of the entire æthalium and cut down at all angles into the homogeneous protoplasm. The first cleavage furrows curve and fork so as to cut off one or more superficial layers of segments. Other furrows cut through the central mass, dividing it up into large blocks, within each of which are many nuclei. There is thus no simultaneous division of the protoplasmic mass into uninucleated portions; and while there is as yet no differentiation of protoplasm to mark out the path of the developing cleavage furrows, this latter was observed at a later stage, when broad hyaline areas are formed midway between each pair of dividing nuclei. A probable explanation of these hyaline areas is that all the denser portions of the protoplasmic mass contract about each nncleus as a center, leaving furrow-shaped, less dense spaces between each pair of nuclei. The cleavage thus predetermined by the hyaline areas is the cleavage by which the entire mass of the æthalium is cut into uninucleated segments. Each of these uninucleated segments, becoming surrounded by a wall, constitutes a spore.

The author compares this method of spore formation with that which occurs in *Synchytrium*, *Pilobolus* and *Sporodinia*, and finds that while they differ in certain important details, they are all identical in their main features. He also deduces the temporary hypothesis, that some form of progressive, rather than simultaneous, cleavage by cell plates prevails in all asexual spore-producing

Fungi. He also concludes that this irregular cleavage of the fungus sporangium indicates a primitive condition when nuclear and cell division are entirely independent processes, and that the correlation of the two has been gradually achieved in the evolution of the higher plants and animals.

Flemming's weaker solution of chromic-osmic-acetic acid was used for fixing the material, while safranin, gentian-violet, and orange were used for staining.

It is gratifying to know that the cytology of the Myxomycetes is being investigated, especially by one who is so capable of handling the subject.

Chicago. A. A. LAWSON.

Land, W. J. G. Double Fertilization in Compositæ. Bot. Gaz. **30**: 252–260, pl. 15–16, 1900.

This short paper, with two plates, describes double fertilization in *Erigeron philadelphicus* and *E. strigosis*, and also in *Silphium integrifolium*, *S. terebinthinaceum* and *S. laciniatum*. In both genera the spermatozoids are coiled, and one fuses with the endosperm nucleus while the other fuses with the egg nucleus. The author regards the fusion with the endosperm nucleus as a genuine fertilization, and thinks it reasonable to regard the endosperm as a potential sporophyte which does not develop such a definite structure as the embryo which develops from the egg.

He suggests that the fusion of the three nuclei to form the primary endosperm nuclei may account for the extremely rapid nuclear division which is so characteristic of endosperm.

Mr. Land's methods yield elegant preparations of embryo-sacs, fertilization, and embryos. The ovules were carefully dissected out from the ovaries and placed immediately in chromo-acetic acid at a temperature of about 100°C for about two hours. Flemming's safranin-gentian-violet-orange combination and Haidenhain's iron-alum-hæmatoxylin proved to be the most satisfactory stains for pre-fertilization stages, and cyanin and erythrosin for fertilization itself. The latter combination was particularly satisfactory after the sections had been treated with acetic acid and chloroform. C. J. C.

Nawaschin, S. Ueber die Befruchtungsvorgänge bei einiger Dicotyledoneen (Vorläufige Mittheilung). Ber. d. deutsch. bot. Gesell, **18**: 224–230, pl. 9, 1900.

This paper, by the discoverer of double fertilizations, adds *Delphinium elatum*, *Helianthus annuus*, and *Rudbeckia speciosa* to the list of plants in which a fertilization of the endosperm, as well as of the egg, has been observed. The writer may have been led to try the Compositæ by the two very spermatozoid-like male cells in the pollen grain of *Silphium* as described by Merrell.

Professor Nawaschin also examined several tropical orchids, and found, instead of a single definitive nucleus, a group of three which had not fused. It has long been accepted that no endosperm is formed in orchids, and the conclusion is drawn that where fusion takes place, there endosperm will be formed, and where fusion fails to occur, there will be no endosperm. When we recall the power of nuclear division, independent of any fusion, as displayed by Gymnosperms, this conclusion seems rather more sweeping than present observations can warrant. C. J. C.

CYTOLOGY, EMBRYOLOGY, AND MICROSCOPICAL METHODS.

AGNES M. CLAYPOLE.

Separates of papers and books on animal biology should be sent for review to
Agnes M. Claypole, Sage College,
Ithaca, N. Y.

CURRENT LITERATURE.

Vincent, S. The Carotid Gland of Mammalia and its Relation to the Suprarenal Capsule, with some Remarks upon Internal Secretion, and the Phylogeny of the latter organ. Anat. Anz. 18: 69–76, 1900.

The author refers to the old comparison of the carotid gland with the "axillary hearts" of selachians made in 1862 by Luschka, to show how old the suggestion is. Later came the idea that these "hearts" and the rest of the "paired suprarenal bodies" had a connection with the suprarenal capsule. Then followed a definite statement of the relationship of the carotid gland to the medulla of the capsule and the masses of chromogenic cells in connection with the abdominal sympathetic; also the possible phylogenetic origin of the carotid and coccygeal glands and chromogenic cells of the sympathetic ganglia from the "paired suprarenals" of selachians (Vincent). This work has been recently confirmed by Kohn (Arch. f. Mikr. Anat. 56, 1900) in his studies on the carotid gland, but this author takes a different view as to the morphology of the suprarenal constituents; however, the difference is largely one of terminology. Kohn's views on the nature of internal secretion are discussed. He points out that many tissues and organs furnish an extract which produces a physiological effect on injection into an animal. This fact does not, however, prove that it is the function of the organ or tissue to secrete the active ingredient of this extract. It has recently been shown that extracts of all parts of the nervous system contain substances which, injected into the blood-vessels of an animal, lower the blood pressure. But it is rash to infer that the formation of this substance is one of the functions of the nervous system. Extracts can, however, be obtained from some organs producing such unusual physiological effects that an inference as to the function of the organ and the nature of the substance as an "internal secretion" is safe. An organ producing such a substance is the medulla of the suprarenal capsule. The active principle of this, in a proportionate dose of not more than one-millionth part of a gram per kilo of body weight, will produce distinct physiological results on the heart and arteries (Schäfer. Text-book Physiol., 1898). It has not yet been proved that the carotid cells contain this active substance; it has merely been shown that they contain the same chromogen. A physiological proof could hardly be obtained even if sufficient quantities of extract were produced, because there would be present so much nervous tissue which would act in the opposite way and counteract its influence. It is certainly extremely probable that the medulla of the suprarenal capsule is constantly secreting an active material into the blood stream, which acts beneficially on the muscular tissue of the body. It has been stated, and later confirmed, that the

blood of the suprarenal vein contains enough of this substance to produce a marked rise in blood pressure when intravenously injected.

These arguments all support the view previously expressed by the author, that the suprarenal capsule in vertebrates is made of two distinct glands—cortex and medulla. The two constituents show progressive development in ascending the vertebrate scale, the medulla becoming more and more glandular in mammals. The sympathetic origin of the medulla is revealed by the histological structure in adult elasmobranchs, amphibians, reptiles, and birds, where transition forms are found between nerve-ganglion cells and the proper cells of the medullary substance. The adult medullary gland is nervous in origin, but glandular in its nature, producing a characteristic internal secretion. The medulla of the suprarenal capsule in higher vertebrates corresponds to the paired suprarenal bodies along the sympathetic in elasmobranch fishes. One cortex in the higher orders corresponds to the interrenal body in elasmobranchs. The author concludes with a discussion of Dr. Aichel's papers (Anat. Anz. 17, 1900, No. 1. Separatabdruck, a. d. Sitzber. d. Physikal Med. Soc. zu Erlangen (undated). Archiv. f. Mikr. Anat. 56, 1900), in which he advocates views entirely at variance with Vincent's conclusion. It is shown that these views are based on insufficient evidence.

A. M. C.

Hohngren, E. Von den Ovocyten der Katze. Anat. Anz. **18**: 63–69, 1900.

Starting on studies in nerve-cells, the author undertook some researches on the intracellular sap canals to be found in different kinds of cells. He was led to expect such structures in egg-cells, and began some investigations on the ovarian eggs of new-born guinea pigs, cats, and dogs, and found the best results from the tissue of new-born kittens. As a hardener and fixer, an alcohol-chloroform-acetic acid mixture gave the best results. The sections were stained with iron, hæmatoxylin, acid fuchsin, and orange, and gave very beautiful results. The epithelial nests are of different kinds, genuine pockets of Pflüger are common, and hence primordial follicles are not numerous; they only appear here and there in the deeper layers. In the pockets are found egg-cells in the various stages of division, all the steps of which process are clearly brought out by the staining method used. Somewhat deeper in the ovary most of the egg-cells are in their period of growth; of these the author speaks more fully. Looking at the cell from the outside the large nucleus is seen to be eccentric, and close to it there is a more or less marked round mass of granules, which stain orange, as does the protoplasm. In most cases there is present in the middle of this granular mass a small, spherical or often more or less irregular body, that does not stain with orange but with acid fuchsin. It is never homogeneous, but appears sometimes as if made of several cross, at others of several longitudinal rods, which often wind round each other, sometimes enclosing canal-like formations. Very often it appears that this body is shrunken away from the surrounding granules, probably due to the process of preservation. The whole mass of granules is often of a round or oval form, sometimes crescentic, enclosing a larger or smaller part of the nuclear boundary. A close examination shows that the whole fuchsin-stained structure can appear sometimes centrally in the body of the egg-cells without being surrounded by any special mass of granules, sometimes penetrating from

outside into the cell body. It appeared as if the bodies in question represent definite processes, running from the outside of the cells, and similar in form to mesenchymatous differentiations. Their color reaction with hæmatoxylin, acid fuchsin, and orange is the same as that of connective tissue, also their penetration from outside into the egg-cells, and the collection of orange-staining granules at the end deepest in the cells. Besides these processes, there are present round or irregular masses having a basic character. Very often the nuclear chromosomes show a converging arrangement towards that border of the nucleus against which the mass of granules has been heaped, an arrangement that shows, perhaps, an influence of this structure upon the cell nucleus. From the structure of the processes spoken of, and their relation to the granule masses, the author feels justified in believing it to be of a nature similar to the "vitelline body" of Balerani and yolk nucleus of other authors. It appears worthy of note that the granular or "vitellogenous" layer is always connected with the processes before mentioned. This relation suggests that the reserve food material of the egg-cell may be carried by means of these mesenchymatous processes: it is not impossible that the fine canals observed have the nature of lymphatic channels. Authors who have studied this structure—the yolk nucleus—are very generally agreed it is the center of dentoplasmic formation. Although similar processes have been observed in ovogonia in the multiplication period, it is significant that numerous intracellular processes first appear in the growth period, and are present before the formation or the reserve material. Another structure worthy of note was found with a deep iron-alum-hæmatoxylin stain; small smooth fibres penetrating into the egg-cell. They are more or less twisted, and appear directed toward the yolk nucleus; here and there similar threads are seen lacking this direction. Their nature is as yet undecided. To summarize, it is clear to the author that the processes penetrating the ovocyte have to do with the deposition of dentoplasm, and hence with the growth of the cell, perhaps also with the simultaneous enlargement of the nucleus of the ovocyte. A. M. C.

Loeb, J. On the Artificial Production of Normal Larvæ from the Unfertilized Eggs of the Sea Urchin (Arbacia). Am. Jour. of Physiol. 3: 435–471, 1900.

The author reviews work already done along the same line of study, and shows that the effect of salts added to sea water in causing unfertilized eggs to segment, has already been demonstrated by many workers. There may be a cleavage of the nucleus alone, or cytoplasmic cleavage may accompany it; also there may be cytoplasmic cleavage without nuclear (Morgan). A discrimination is necessary between two effects produced by the addition of salts or increased concentration of the sea water. One is the change in the nucleus causing a solution of the cell membrane, also, perhaps, the substance having the chromosomes together. Within certain limits this effect increases with concentration. The other effect is the gradual suppression of the motility of the protoplasm, possibly due to decrease in fluidity. This effect, too, increases with concentration. At a certain point of concentration the nuclear membrane dissolves, and chromosomes scatter, but the protoplasm no longer divides; increased concentration still causes a solution of the nuclear membrane, but no scattering of chromosomes nor segmentation of protoplasm follows. Such eggs put back into

normal water regain first the power to move the chromosomes, and later that of protoplasmic cleavage.

Experimentation was begun upon fertilized eggs; five minutes after fertilization they were put into various solutions. With one chloride in solution ($\frac{5}{8}$ n NaCl) from 20 to 50 per cent. of the eggs began cleavage, rarely reaching 16 cells, mostly stopping at 2 cells. In a $\frac{5}{8}$ n KCl solution 70 to 80 per cent. segmented, and many reached the 8-celled stage, slight dilution permitted many to become 16-celled. Further experiments with $MgCl_2$ showed this salt to be, on the whole, more favorable than either of the preceding. $Ca\,Cl_2$ was less so, also LiCl. With 2 chlorides, eggs do not reach the blastula stage, but develop faster than with only one, but neither with 1 nor 2 chlorides in solution could swimming blastulæ be obtained. With 3 salts, Na Cl, $Ca\,Cl_2$, and KCl, free-swimming, active blastulæ were formed, which developed to the gastrula and pluteus stages, and lived for some 10 days in the solution. It is possible to vary the proportions of K and Ca-ions within certain limits, provided they are present in sufficient quantity; but no other 3 chlorides will give freely swimming blastulæ. It is seen that a given mixture of Na Cl, KCl and $Ca\,Cl_2$ allows of the formation of a gastrula, but it is proved by experiments on Fundulus that the kations are not necessary for growth, since young fish will live indefinitely in distilled water. It is safest to conclude that for processes of cell division and development, a certain physical condition, a certain labile equilibrium, of protoplasm has to be maintained. This requires certain ions in definite proportions. This introduces a new conception, that of physiologically balanced salt solution; solutions containing such ions in such proportions as to counteract the poisonous effects which each constituent alone in solution would have. Sea water and blood are such solutious. The next line of experiments was to determine the possibility of producing blastulæ from *unfertilized* eggs without raising the concentration of the sea water. It was found that cleavage might occur, but development never proceeded further than the beginning of segmentation. At no time during the development of unfertilized eggs is an egg membrane formed, so that the condition of the egg in this respect is readily determined. Leaving eggs of both kinds in a mixture of 60 cc. $\frac{20}{8}$ n $Mg\,Cl_2$ and 40 cc. of sea water, it was found that fertilized eggs formed a membrane, and unfertilized not, while in both cases more than 50 per cent. of the eggs had reached 2- or 8-celled stages, there being almost no difference in per cent. between the two. It was clear, also, that Mg-ions secured more normal changes than K, Na or Ca, and these act favorably in the order named. For the production of normal larvæ from unfertilized eggs, the experiments were most carefully conducted to avoid any possible infection with spermatozoa, and most careful control experiments carried out. It was found that by putting the unfertilized eggs of Arbacia for 2 hours in a solution of 60 cc. $\frac{20}{8}$ n $Mg\,Cl_2$ + 40 cc. sea water, eggs would develop into blastulæ if brought back into normal sea water. Putting similar eggs into a solution of equal parts of $\frac{20}{8}$ n $Mg\,Cl_2$ and sea water for the 2 hours they reach the pluteus stage. Check experiments were made by keeping some eggs from the same lot in normal sea water, where no development occurred, hence no fertilization by contamination took place from the sea water used. None of the eggs developing after treatment

with $Mg\,Cl_2$ possessed a membrane. Eggs were taken from the chloride mixture after different lengths of time, and in no case did development of a blastula occur for less than one-half hour's immersion. Eggs left for more than two and one-half hours yielded few or no blastulæ. The possibility that the sea water contained spermatozoa capable of fertilizing eggs treated with the chloride, but incapable of so acting on normal eggs, was excluded by the following experiment: Eggs from the same lot were kept part in normal sea water and part in half and half sea water and $Mg\,Cl_2$ mixture for 2 hours; then both lots were fertilized. Practically every egg of the former lot developed to blastulæ normally, while only 50 per cent. of the latter did so, showing that $Mg\,Cl_2$ *does not increase* the power of development of eggs, but *diminishes* it. The difference between blastulæ and plutei developing from fertilized and unfertilized eggs is that the former rise to the top of the water, while the latter remain at the bottom. If eggs are kept for 2 hours in the $Mg\,Cl_2$ solution and then fertilized with normal sperm the blastulæ rise to the surface; if they are fertilized with sperm, kept 2 hours in the $Mg\,Cl_2$ solution, they remain at the bottom. The author finally states that these experiments remove the problem of fertilization from the realm of morphology to that of physical chemistry, the morphology of the spermatozoan becomes of secondary importance so far as the process of fertilization is concerned. A separation must then be made between the spermatozoan as a bearer of hereditary qualities and as a starter of non-parthenogenetic development. The production of plutei by the parthenogenetic process means the development of eggs as far by this method as is possible in a laboratory by any means as yet tried. The duration of life with these larvæ is as long as that for fertilized plutei, so the processes can in so far be considered closely allied. A. M. C.

NORMAL AND PATHOLOGICAL HISTOLOGY.

RICHARD M. PEARCE, M. D.

University of Pa., Philadelphia, Pa., to whom all books and papers on these subjects should be sent for review.

Mallory, F. B. A Contribution to Staining Methods. The Journal of Experimental Medicine, Vol. V, No. 1, 1900.

I. A Differential Stain for Connective-Tissue, Fibrillar, and Reticulum.

1. Fix in corrosive sublimate or in Zenker's fluid.
2. Embed in celloidin or paraffin.
3. Stain sections in 1/20 – 1/10 of one per cent. aqueous solution of acid fuchsin 1 to 3 minutes.
4. Wash in water.
5. Place in one per cent. aqueous solution of phosphomolybdic acid for one minute or longer (use platinum or glass needle).
6. Wash in two changes of water.
7. Stain in the following solution for 2 to 20 minutes or longer:

Anilin blue soluble in water (Grübler),	0.5
Orange G (Grübler),	2.0
Oxalic acid,	2.0
Water,	100.0

8. Wash in water.
9. Dehydrate in 95 per cent. alcohol.
10. Blot on slide and clear in xylol, or clear in oleum origani cretici.
11. Xylol balsam.

Mallory recommends this stain on account of its simplicity, and because he believes it the best yet proposed for the purpose.

It is not absolutely differential, because it also stains certain hyaline substances.

The fibrillar and reticulum of connective tissue, amyloid, mucus, and certain other hyaline substances stain blue; nuclei, protoplasm, elastic fibres, axis cylinders, neuroglia fibres, and fibrin, red; red blood-corpuscles and myelin sheaths, yellow.

The connective tissue may be brought out more sharply by omitting the acid fuchsin.

The method is satisfactory only after hardening in corrosive sublimate solution or in Zenker's fluid. With alcohol and other fixatives everything stains blue.

Paraffin sections require longer staining than celloidin sections.

The method can be used also for the study of the central nervous system, especially after the following fixation:

1. Place thin pieces (2 to 5 mm. thick) in a four per cent. solution of formaldehyde (ten per cent. formol) for at least four days.
2. Saturate aqueous solution of picric acid, four days or more.
3. Five per cent. aqueous solution of bichromate of ammonium, four days in the incubator. Solution should be used in abundance, and changed at the end of twenty-four hours.

Stain as follows:

1. One per cent. aqueous acid fuchsin, 2 to 5 minutes.
2. Water quickly.
3. One per cent. aqueous solution of phosphomolybdic acid, 1 to 2 minutes.
4. Wash in two changes of water.
5. Anilin blue and orange G. solution, 1 to 3 minutes.
6. Water, etc., as in previous stain.

Connective tissue, blue; neuroglia fibres, deep red; axis cylinders and ganglion cells, a light red.

II. Chloride of Iron Hæmatoxylin for Nuclei and Fibrin.

This method may be used after all of the usual fixing fluids except, perhaps, formaldehyde. Celloidin or paraffin may be employed for embedding.

1. Stain sections on slide for 3 to 5 minutes in a ten per cent. aqueous solution of ferric chloride.
2. Drain and blot the sections; then pour over them a few drops of a

freshly prepared one per cent. aqueous solution of hæmatoxylin. If all the hæmatoxylin is precipitated, pour off the solution and add a fresh supply. In 3 to 5 minutes the sections will be colored a dark bluish black.

3. Wash in water.
4. Decolorize and differentiate in a 1/4 per cent. aqueous solution of ferric chloride, constantly moving section. The differentiation takes a few seconds to one or more minutes.
5. Wash in water.
6. Dehydrate in alcohol.
7. Clear in oleum origani cretici.
8. Xylol balsam.

Nuclei take a sharp, dark blue, permanent stain; fibrin, grayish to dark blue. In Zenker's preparations the red blood-corpuscles are of a greenish-gray color. Connective tissue is tinted a pale yellow.

The hæmatoxylin used must not be more than one or two days old.

III. Phosphotungstic Acid Hæmatoxylin for Neuroglia Fibres.

This is a modification of the method originally published by the same writer in the *Journal of Experimental Medicine* in 1898 (Vol. III, p. 611).

The tissues should be fixed by the formaldehyde, picric acid, and bichromate of ammonium method described under the connective tissue stain:

1. Place sections in a one-half per cent. aqueous solution of permanganate of potassium for 15 to 30 minutes.
2. Wash in water.
3. One per cent. aqueous solution of oxalic acid 15 to 30 minutes.
4. Wash in 2 to 3 changes of water.
5. Stain in the following solution 12 to 24 hours or longer:

Hæmatoxylin, ...	0.1
Water, ...	80.0
Ten per cent. aqueous solution of phosphotungstic acid (Merck), ...	20.0
Peroxide of Hydrogen (U. S. P.), . . .	0.2

Dissolve the hæmatoxylin in a little water by the aid of heat, and add it, after cooling, to the rest of the water and the acid. Then add the peroxide of hydrogen.

6. Wash quickly in water.
7. Ninety-five per cent. alcohol.
8. Oleum origani cretici.
9. Xylol balsam.

Nuclei, neuroglia fibres, and fibrin stain blue; axis cylinders and ganglion cells, pale pink; connective tissues, deep pink.

If a permanent isolated stain of the neuroglia fibres is desired, place the sections after step 6 in a thirty per cent. alcoholic solution of ferric chloride for 5 to 20 minutes, then wash in water and dehydrate as before. The nuclei, neuroglia fibres, and fibrin stand out sharply, of a clear blue color; everything else is decolorized, or appears of a pale yellowish or gray tint. R. M. P.

CURRENT BACTERIOLOGICAL LITERATURE.

H. W. Conn.

Separates of papers and books on bacteriology should be sent for review to H. W. Conn, Wesleyan University, Middletown, Conn.

Auché et Hobbs. De la tuberculose chez la Grenouille Arch. d. Med. Exp. **12**: 419, 1900.

The question whether the tubercle bacillus can produce an infection in cold-blooded animals has been studied at length by these authors. Their experiments were made upon the frog. They find that when inoculated sub-dermally, or in the stomach, no result is produced. When bacilli are injected into the peritoneum there is excited at once an active phagocytosis. Later there is formed, in most cases upon the liver, but sometimes upon other viscera, small granulations which contain the bacilli in great numbers. The number of granules does not vary with the length of time after the inoculation, but the number of bacilli diminishes with the age of the granulation. The bacilli are also found for some weeks irregularly distributed in the viscera. The virulence of the bacilli is slightly modified by their sojourn in the frog, and they remain active for a long time. Dead tubercle bacilli produce results identical with those of living bacilli, and under no conditions does there seem to be any multiplication of the bacilli in the body of the frog, at ordinary laboratory temperatures. The authors experiment with both human and avian bacilli, and find no evidence that the one is converted into the other.

Lubarsch. Ueber das Verhalten der Tuberkelpilze im Froschkörper. Cent. f. Bak. u. Par. I, **28**: 825, 1900.

This author describes experiments upon a subject kindred to the above, reaching slightly different conclusions. He injects the human tubercle bacilli into the lymph spaces of frogs. He finds that from here they regularly migrate into the inner organs of the body, and can be detected after months. Small granules are sometimes found at the point of inoculation, but rarely in the internal organs. The bacilli, after a week's sojourn in the frog, are no longer pathogenic for guinea pigs, a loss of virulence that occurs more quickly if the original culture is only slightly virulent.

Schierbeck. Ueber der Variabilität der Milchsäurebacterien mit Bezug auf des Gährungsfähigheit. Arch. f. Hyg. **37**: 294, 1900.

The author has investigated the question whether the fermentative power of bacteria is subject to the same range of variability as are the chromogenic and other properties, which have been hitherto studied. He chooses for this purpose the production of lactic acid, and experiments with the most common type of lactic organism in milk (*B. lactici acidi*, Gunther). The result is to demonstrate that this property is very variable. As a measure of the fermentative power, he uses the amount of acid produced under similar conditions. Selecting a number of different cultures of the same species of organism from the same lot of milk, he finds that the fermenting power varies in accordance with his scale, from 50 to 100. The fermentative power of any given

culture is retained constant through a long series of cultures. These cultures he regards as varieties, since he is able sometimes to obtain similar varieties from a single colony of the bacillus. But these cultures, even when derived from a single colony, retain for many generations their original fermentative power, and are thus permanent varieties. He finds that the fermentative power is in a measure parallel with the rate of multiplication of the bacteria, and, lastly, that by the use of carbolmilk, he can reduce the fermentative power of any culture, thus producing artificial varieties similar to those which he finds in nature.

Bonhoff. Ueber das Vorkommen von Tuberkelbacillen in der Marburger Butter und Margarine. Hyg. Rund. **10**: 913, 1900.

In the last few years many bacteriologists have made examinations of butter for the purpose of determining the presence or absence of the tubercle bacillus. In the great majority of cases this bacillus has been found in the butter sold in European markets. It is, therefore, somewhat interesting to learn that Bonhoff reaches the opposite result in the study of the butter in Marburg. He studied thirty-nine samples of butter and seven of margarine, and though his experiments were carefully performed he found no tubercle bacilli in any sample.

Roger and Garmer. Compt. Rend. de la Soc. Biolog., 175, 1900.

The authors report a case of a human mother with pulmonary tuberculosis in whose milk the tubercle bacillus was found. The milk inoculated into guinea pigs produced tuberculosis. A child of this patient, who was suckled only from the third to the sixth day after birth, died in six weeks, and a post mortem examination showed numerous tubercles in the abdominal organs. The mother's breast appeared perfectly healthy, certainly showing no signs of tubercles.

Morgenroth. Versuche über Abtödtung von Tuberkelbacillen in Milch. Hyg. Rund. **10**: 865, 1900.

The author carried on these experiments upon the much investigated topic of the relation of the tubercle bacillus to the heat death point. He concludes, in brief, that in milk the tubercle bacilli cannot be, with any certainty, killed by a temperature of 70° C, unless it is continued for longer than ten minutes, and indeed for about half an hour. Further, he states that when heated to 100° C, the temperature must be retained from three to five minutes in order to insure the death of the bacilli. The latter is the more necessary if the heated milk is to be subsequently quickly cooled.

Vejdousky. Bemerkungen über den Bau und Entwicklung der Bakterien. Cent. f. Bak. u. Par. **2**: 577.

This article describes an exceptionally large bacillus, 9μ to 10μ by 2μ to 2.2μ in size, which was found within the body of a species of Gammarus. The forms especially described by the author appear to have been resting stages of the bacillus. Microscopical study showed the presence of various vacuoles and cytoplasm aggregations, much like those described in other bacteria. The especial feature of the article, however, is the discovery of what the author regards as a *true nucleus*. In the body of every individual, lying close to the center of the cell, is a round, clearly defined, definitely staining body, which has every resemblance to a nucleus. The author finds no nuclear membrane, which he attributes to the minute size of the cells; he

finds no division stages of the nucleus, which he explains by the fact that his cells were all in a resting stage. He is confident, however, that he has discovered a true nucleus.

Gabritschewsky. Ueber active Beweglichkeit der Bakterien. Zeit. f. Hyg. u. Infec. **31**: 104, 1900.

This paper is something of a novelty in attempting to measure the rapidity of the locomotion of bacteria. The author devises several means of testing this, all of which are based upon the rapidity with which bacteria distribute themselves from a central point. What is thus measured is not, of course, the actual rapidity of locomotion, but rather a combination of locomotion and reproduction; for the rapidity of distribution from a central point is dependent partly upon the rate of multiplication. The essence of his methods is to place a number of motile organisms at a central spot, and then at intervals test the surrounding medium at different distances from the central point, for the presence of the organism. The author suggests a certain practical use of such methods in separating motile organisms from those that are not motile, or even separating from each other organisms whose rate of motion varies. He suggests that the method may be applicable to the isolation of the typhoid bacillus from the colon bacillus in water, fæces, or other contaminated material. H. W. CONN.

NOTES ON RECENT MINERALOGICAL LITERATURE.

ALFRED J. MOSES AND LEA McI. LUQUER.

Books and reprints for review should be sent to Alfred J. Moses, Columbia University, New York, N. Y.

New Minerals, occurring in the nepheline-syenite of Julianehaab, Greenland. Bull. Soc. Min. **23**: 25, 1900.

ANCYLITE.—$4\,Ce(OH)CO_3 + 3\,SrCO_3 + 3\,H_2O$. Orthorhombic.—Small, indistinct crystals, with curved octahedral-like faces. Color, yellowish-orange, yellowish-green, brown or gray; lustre, vitreous on faces and oily on fracture; G.=3.95; H.=4.5. Similar to Brögger's weybyeite.

BRITHOLITE.—$3\,[4SiO_2,\ 2(Ce, La, Di, Fe)_2O_3,\ 3(Ca, Mg)O,\ H_2O,\ Na\,F],\ 2\,[P_2O_5, Ce_2O_3]$. Orthorhombic.—Small twinned crystals resembling hexagonal prisms. Color, brown. Described by Winter, also noted by Flink.

CORDYLITE.—$Ce_2\,F_{12}\,Ba\,C_3O_9$. Hexagonal.—Very small (3x1 mm.) prismatic crystals, with pyramidal terminations. Color, pale yellow to colorless, darker when altered; fracture, conchoidel; cleavage, distinct, parallel to base; H.=4.5; G.=4.31. Occurs implanted on ægirite. Mineral practically a barytoparisite, with Ba replacing Ca.

EPISTOLITE.—$19SiO_2,\ 4TiO_2,\ 5Nb_2O_5$, (Ca, Mg, Fe, Mn) O, 10 Na O, $21H_2O$, 4 Na F. Monoclinic.—Crystals in rectangular, thin plates (parallel to base). Color, white; extremely fragile; G.=2.885; H.=1—1½. Found in pegmatite vein, and in mass of granular albite.

LEUCOSPHENITE.—$BaNa_4$ $(Ti\,O_2)$ $(Si_2O_5)_5$. Monoclinic.—Crystals wedge-shaped and very small; color, white; cleavage, distinct, parallel (010); G.= 3.05; H=6.5. Decrepitates and fuses with difficulty. Decomposed by hydrofluoric acid. Analagous in composition to pectolite.

LORENZITE.—Na_2O, 2 $(Ti, Zr)O_2$, 2 SiO_2. Orthorhombic.—Very small (1 mm. long) elongated crystals, with pyramidal terminations; faces in vertical zone often striated. Transparent, with ends of crystals sometimes black. G.=3.42; H.= 6+. Fuses easily to black lead. Soluble only in hydrofluoric acid.

NARSARSUKITE.—Ti_2 Si_{12} O_{22} Na_6 Fe F. Tetragonal.—Crystals often have base as principle form. Color, honey-yellow to brownish.

SCHIZOLITE.—15(Si, Ti)O_2, 10 (Ca, Mn, Fe, Ce)O, 4(Na, H)$_2$O. A manganiferous pectolite of rose to brown color. Described by Winter.

SPODIOPHYLLITE—$(Al, Fe)_2$ $(Mg, Fe, Mn)_3$, $(Na_2, K_2)_2$, Si_8O_{24}. Rhombohedral.—Small, chlorite-like crystals of triangular section. Color, ash-gray; G.= 2.633; H=3.5. A metasilicate, approaching ægirite or arfvedsonite.

TAINIOLITE.—$(MgOH)_2$ (K, Na, Li) $Si_3O_8+H_2O$.—Small (5 x 1 mm.) band-like crystals, belonging to mica group. 2E about 50 °; G. 2.86; H.=2.5—3. Fuses and colors flame red. Slowly soluble in hydrochloric acid.

CHALCOLAMPRITE.—R″ $Nb_2O_6F_2$+R″ SiO_3. Isometric.—Regular, octahedral crystals, often with cracks containing ægirite needles. Color, dark brownish-gray; lustre, metallic; G.=3.75; H.=5.5. Belongs in the pyrochlore group.

ENDEIOLITE.—R″ Nb_2O_6 $(OH)_2$+R″SiO_3. Isometric.—Very small, octahedral crystals; spinel twins observed. Color, deep chocolate-brown; lustre, metallic; G.=3.44; H.=4. Belongs in the pyrochlore group, but differs from the other species by SiO_2 replacing TiO_2, ThO_2, etc. L. McI. L.

NEWS AND NOTES.

PREPARATION OF SEEDS FOR STUDY.—Boil the seeds first in water, then in weak caustic potash; neutralize the potash with acetic acid and shake in a test-tube. By this treatment the closely adhering layers of the seed coat are readily loosened.

A NEW MACERATION MEDIUM FOR PLANT TISSUES.—With the exception of caustic potash, the most useful macerating media for plant tissues are of an acid nature. Concentrated ammonia solution (NH_3) has been used with success to separate plant tissues into their elements. The elements and their contents are less injured, and are therefore much better preserved than is the case with other methods. The ammonia solution may be used hot or cold, the rapidity of action depending upon the temperature of the solution.

A supply of fruiting Vaucheria may be obtained at any time of the year by

carefully removing the mats from pots in green-houses and throwing them into a jar half full of water. The jar should be placed in strong sunlight, and after five or six weeks the material may show both methods of reproductions, and will be practically free from dirt or other Algæ.

Rhizopods are common in the slime on submerged rocks, stems, and leaves; especially so in moist situations not too much shaded, among decaying logs, mosses, lichens, and on the bark of trees.

To mount the antennæ of flies, wasps, and bees, soak the objects in chlorate of potash, with a few drops of hydrochloric acid, until they are colorless, and then mount in Canada balsam and benzole.

To Kill Rotifers.—To kill and preserve rotifers with their cilia fully expanded and in their natural condition, Mr. Rousselet first narcotizes them with a solution consisting of 3 parts of a 2 per cent. solution of hydrochlorate of cocaine, 1 part of methylated spirits, and 6 parts of water. The rotifers should first be isolated in a watch glass of clean water, and a drop or two of the solution added; after 5 or 10 minutes another drop should be added, and afterwards drop by drop—very slowly—until the animals are completely narcotized. They may then be killed and fixed by adding one drop of an eighth per cent. to a fourth per cent. solution of osmic acid. To clear from the solution they must be washed several times, and then transferred to a 2½ per cent. solution of formaldehyde, and should be mounted in the fluid in hollow-ground glass slips.

Suggestions for Glycerin Jelly Mounts.—To facilitate the handling of small mounts of mosses and sections of organs in jelly between mica, the following simple method is recommended: Take two thicknesses of paper, one of ordinary writing paper, the other card-board slightly heavier than postal-card paper. From each cut out strips of equal size as long as ordinary microscope slides and a very little wider. Fasten these at one end with paste to keep them from slipping. Lay the glycerin jelly mount, which of course must not be as wide or as long as the paper slide, on this paper slide, and centering it, mark off a space a little less than the size of mount; cut this space through both thicknesses with a sharp-pointed pen-knife; cover the inside of the card-board with paste, lay down over it, properly centered, the jelly mount, and press down the thin paper, carefully avoiding any displacement. The paper thus becomes a frame for the mount, upon which may be kept desired data, and which makes preservation of mount less difficult.

By the use of Romanowski's liquid—a mixture in certain proportions of methylen blue and eosin employed by him and by Liemann for the demonstration of the plasmodia of malaria—Feinberg has discovered within bacteria of different kinds a body which evidently corresponds to a nucleus, in so far, at

least, as it seems to be composed of chromatin, and which colors with the liquid in question of a brilliant crimson, while the remainder of the organism stains blue.

Recent experiments by McFadyean upon African horse-sickness seems to show that blood from an infected animal, when passed through a Berkefeld or Chamberland "F" filter, still retains its power of conferring the disease. This, according to McFadyean, tends to prove that the organism which transmits the disease is smaller than any of the known bacteria, and makes it highly probable that it is too small to be made visible to the human eye aided with the highest powers of the best modern microscope.

INLAND BIOLOGICAL LABORATORIES.—During the past three summers research work has been carried out on the Great Lakes under the auspices of the U. S. Fish Commission. In botanical work, Dr. Julian W. Snow has been engaged in determining the Algæ of Lake Erie, and in working out their life history. Mr. A. J. Pieters and Mr. R. H. Pond have pursued the study of the aquatic plants, with the purpose of determining whether they are wholly dependent on water for nutrition, or partly on the soil. In zoölogical work collections of the invertebrate forms of the lake (Erie) have been made; also collections of the contents of fish stomachs, and of the parasites of the aquatic vertebrates. Plankton work has been carried on by Prof. Reighard and Dr. H. B. Ward. They have devised an apparatus for measuring the actual flow of water through the plankton net.

At the Illinois State Laboratory of Natural History, Prof. S. A. Forbes has charge of continuous investigation of the aquatic life of the state.

In the absence of Prof. C. H. Eigenmann during the past season, Dr. Robert E. Lyons has had charge of the Indiana University Biological Laboratory, where research work along many lines has been pursued.

Investigations of the biology of aquatic insects have been carried on at the entomological field station of the New York State Museum, under the direction of Prof. James G. Needham of Lake Forest University.

The fauna of the Northern Mississippi and the Minnesota rivers has been under investigation, with Prof. U. O. Cox of Mankato as immediate director. A house-boat has been used with great satisfaction and economy in the work.

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MICRO-CHEMICAL ANALYSIS.

VIII.

SODIUM—Continued.

Ammonium Fluosilicate added to solutions containing Salts of Sodium rise to the formation of Sodium Fluosilicate.

$$2\,NaCl + (NH_4)_2SiF_6 = Na_2SiF_6 + 2\,NH_4Cl.$$

Method.—A drop of a neutral or slightly acid solution of the material to be tested is placed upon a *celluloid* slip, or upon a balsam or wax covered slide, and to it a tiny fragment of pure, dry ammonium fluosilicate is added. If sodium is present, six-sided prisms and hexagonal disks are almost immediately formed. The former end either in flat basal planes or, more often, in short pyramids. In concentrated solutions, especially if acid, there first appear skeleton crystals in the form of six-pointed rosettes and stars; less frequently skeletons resembling snow crystals are obtained (see Fig. 25).

Remarks.—The salt Na_2SiF_6 belongs to the hexagonal system, polarizes but feebly, and, unless very thin crystals are formed, exhibits a faint yet distinct rosy tint.

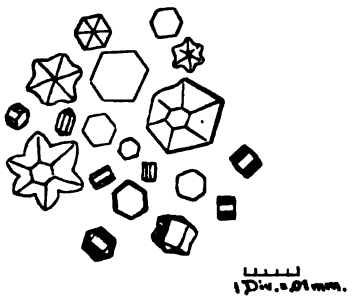

Fig. 25.

The corresponding potassium salt of like formula is much more soluble, separates only from decidedly concentrated solutions, and crystallizes in small, colorless cubes, octahedra, combinations of these two, or in dodecahedra (isometric). There is no possible danger, therefore, of confusing these two elements. It is well to remember, however, that undue development of the diagonally opposite faces of an octahedron yields a crystal giving an image hexagonal in outline. The color of the crystal and its action on polarized light should leave no room for doubt.

From very concentrated solutions, in addition to potassium, Li, Ca, Sr, Mg, Mn, Fe, etc., may possibly separate.

Barium, if present, is always precipitated with sodium, forming barium fluosilicate, $BaSiF_6$, which cannot be confused with the sodium salt since the barium

compound crystallizes in rods (see Barium). Neither calcium nor strontium are precipitated by ammonium fluosilicate, but each salt is liable to separate from too concentrated solutions. The calcium salt, $CaSiF_6 \cdot 2H_2O$ (monoclinic), forms spindle-shaped crystals, and though these are grouped in rosette-like masses, they are not to be mistaken for sodium.

In the presence of calcium, the prisms of sodium fluosilicate grow considerably longer than those sketched in the figure, a fact that should be borne in mind when performing analyses.

Like calcium, lithium fluosilicate, $Li_2SiF_6 \cdot 2H_2O$, is monoclinic and will only crystallize from concentrated solutions.

The magnesium salt, $MgSiF_6 \cdot 6H_2O$, though not precipitated by the reagent, crystallizes in rhombohedra which, under certain conditions, following the employment of two concentrated solutions, might lead to error. These crystals are, however, colorless, polarize strongly, and do not take the form of six-sided prisms. The fluosilicate of iron is isomorphous with the magnesium salt.

It is evident that if silicon is present in the material under examination, we can test for sodium and silicon in one operation by adding ammonium fluoride and then acidifying. A precipitation of crystals resembling sodium fluosilicate would point to the presence of sodium and silicon, or an element behaving, under like conditions, similarly to silicon. Thus we have fluotitanates, fluozirconates, fluostannates from elements of the fourth group; and from the transitional elements, glucinum in the second group and boron in the third, we may have fluoglucinates and fluoborates of sodium. Of these compounds the fluotitanate is known to be isomorphous with the fluosilicate of sodium.

In the absence of ammonium fluosilicate, pure SiO_2 and ammonium fluoride can be added to the acidified drop of the solution to be examined.

Neither ammonium fluosilicate nor ammonium fluoride should ever be employed without their having first been tested for the presence of sodium. If the reagents are found to be impure, it is only necessary to sublime them in a platinum crucible, or receive the sublimate on platinum foil held over the material being heated in a platinum cup.

Remember that glass slides cannot be used in this test for sodium; that only low power (one-inch) objectives of great working distance should be employed, and even then the front lens should always be protected in some way, as, for example, with a small cover-glass, held in place with glycerin, oil, or other suitable substance. The preparation should be examined as rapidly as possible, and must be quickly removed from the stage. When the microscope is provided with a nose-piece, it is advisable to remove the objectives not in use before examining any preparations liable to give off hydrofluoric acid or volatile fluorine compounds. The objective must always be thoroughly cleaned after any such tests.

Exercises for Practice.

Test, as directed above, salts of sodium in both neutral and acid solutions.

In order to better appreciate the reasons for employing celluloid slips, place a drop of water on a glass slide, acidulate (but add no sodium), then add the reagent and examine the preparation.

Try to obtain crystals with K, Rb, Cs, Li.
Add a little calcium to a solution containing sodium, and test.
Make a mixture of Na and SiO_2, add acid and NH_4F.
Repeat the last test, using Ti in the place of Si.

IV. With Bismuth Sulphate, Sulphuric Acid Solutions of Sodium Compounds form a Double Sulphate of Sodium and Bismuth.

$$3Na_2SO_4 + 2\,Bi_2(SO_4)_3 = [3Na_2SO_4 \cdot 2Bi_2(SO_4)_3].$$

Method.—The best results seem to follow the addition of a little of the material to be tested, in the form of a sulphate, to a drop of the reagent. For this reason it is advisable to proceed as follows:

At the corner of a slide place a drop of dilute sulphuric acid; add to this drop a little basic bismuth nitrate and stir until the bismuth salt has completely dissolved. Heat carefully until the water has been mostly expelled, and crystallization of the bismuth sulphate takes place; then add a rather large drop of water and a very small drop of dilute nitric acid. Stir for a few moments. The reagent drop should now slowly clear up, and a perfectly clear solution should result. If, however, the quantity of bismuth nitrate employed is excessive, a residue remains; it is then necessary to decant the clear liquid.

On another slide, or better on a platinum foil, heat with dilute sulphuric acid a few particles of the substance to be tested. Drive off the excess of acid; cool and stir to provoke crystallization. If the drop refuses to crystallize, add more of the substance and heat again.

A drop of the reagent prepared as above is placed at the corner of a slide, and to it is added, at the center, without stirring, a little of the moist mass of the material to be tested, taken from the platinum foil. Warm the preparation gently by holding it for a second or two about 1 cm. above the "micro" flame. Cool rapidly, and examine at once.

The sodium double salt separates near the mass of the material in the form of slender prisms, or what appear to be short rods with rounded ends (Fig. 26). The former usually predominate when only sodium is present; the latter, when mixtures are being examined. With a higher power it is seen that the rounded appearance of the ends of the rods is due to the meeting of several planes. Near the circumference of the test drop the prisms are shorter and stouter, and the crystal form more easily made out.

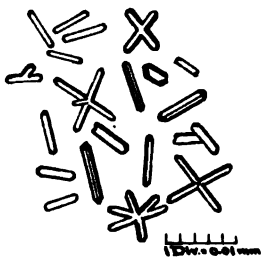

Fig. 26.

Remarks.—The addition of a minute drop of glycerin to the prepared drop of reagent, just before warming, is thought by some workers to give better and more constant results.

Bismuth sulphate is more valuable for detecting potassium than sodium. In the case of the former element, circular and hexagonal disks are formed (see Potassium) having nothing in common with the double bismuth sulphate of the latter element. The reaction owes its chief value with respect to sodium in that it permits of a simultaneous detection of both sodium and potassium.

Ammonium, rubidium, and cesium give hexagonal disks like potassium, hence none of these elements can be confused with sodium. Lithium generally fails to yield any crystals, but when crystallization can be induced, the compound takes the same form as that of the potassium double salt.

The presence of members of the calcium group in large amount may sometimes obscure the reaction for sodium. If such a result is feared, add a very small drop of water to the material which has been treated with sulphuric acid, draw off, and evaporate to crystallization. The addition, to the reagent drop, of a fragment of this last residue will generally furnish better results.

There should be no danger of mistaking the slender needles of calcium sulphate for the prisms or rods of the sodium bismuth compound. Moreover, gypsum is monoclinic, while the double sulphate of sodium and bismuth extinguishes when the cross-hairs are parallel to the length of the rods and prisms.

Exercises for Practice.

See under the methods given for potassium.

V. The addition of Potassium Antimonate to a solution containing Sodium, precipitates Sodium Antimonate.

$$2\ NaCl + H_2K_2Sb_2O_7 \cdot 6H_2O = H_2Na_2Sb_2O_7 \cdot 6H_2O + 2\ KCl.\ (?)^*$$

Method.—Owing to the very low solubility of the reagent it is best to first prepare a solution by boiling a fragment with distilled water. Allow this solution of the reagent to stand a few seconds.

Fig. 27.

Near the test drop, which should be neutral and not too dilute, place a drop of the reagent, and cause the drops to flow together. If the test drop is of the proper concentration, sodium antimonate separates almost immediately in the form of tiny lenticular and fusiform crystals, which soon attain a considerable size and tend to unite in more or less globular masses (see Fig. 27).

The crystals of sodium antimonate separating from dilute solutions are generally tetrahedra, cubes, and octahedra, but these forms are not as characteristic as when the salt is deposited from solutions of ordinary concentration.

Remarks.—If the solution to be tested is acid, neutralize with a little potassium carbonate.

The addition of a little alcohol to very dilute solutions, frequently aids the formation of crystals. It is wiser, however, to first concentrate the solution to be tested.

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* There seems to still be some uncertainty as to the true composition of the reagent "Potassium antimonate" and of the sodium salt precipitated by it. The reagent is sometimes called a "Met-antimonate" and sometimes a "Pyro-antimonate." The majority of our modern authorities consider that the most probable formula for the *granular* potassium antimonate now sold as a reagent is the one which derives the salt from pyro-antimonic acid, in which only two of the four hydrogen atoms are replaced. Since the most recently published work on the antimonates does not seem to have given us sufficient information to warrant the adoption of another formula, the above equation has been given in accordance with the older work.

In the presence of ammonium compounds the sodium salt does not separate as rapidly nor as readily, and its crystal form is usually much modified. Instead of the smooth fusiform crystals, the crystals become angular, though still retaining their spindle-shaped outline, and crystal faces can be readily distinguished.

Ammonium, rubidium, and cesium give rise to no precipitation of crystals even in concentrated solutions.

Lithium gives very pretty hexagons, the formula of the salt probably agreeing with that mentioned above for sodium.

Magnesium yields a salt of similar composition, and also crystallizing in hexagons.

Members of the calcium group almost invariably give rise to the formation of amorphous precipitates, which interfere with the reaction for sodium.

There are so many conditions which may lead to failure, and so many substances which interfere with the tests, that the use of potassium antimonate cannot be recommended for general work. There are, however, cases where this reagent is of undoubted value.

Exercises for Practice.

Try reaction on salts of sodium in both dilute and moderately concentrated solutions.

Try the reagent on ammonium salts alone, then make a mixture of sodium and ammonium salts and try again.

See also suggestions given under Magnesium and under Antimony.

The remaining tests for sodium, mentioned in the preceding list, are of little value save in special cases, a consideration of which would take us far beyond the scope of these introductory articles. These tests can therefore be dismissed with but few words.

The chief objection to their use is the fact that the products formed by the reagents and sodium are so soluble that it is necessary to allow a test drop to evaporate to dryness, or so nearly to dryness that such an amount of other salts will usually also separate, as to seriously obscure the tests.

All the tests mentioned are capable of giving fairly good results when dealing with simple salts; but when complex mixtures are to be analysed the results obtained are generally far from being satisfactory.

VI. Platinum Chloride.

With this reagent, which is better termed *Chlorplatinic Acid*, salts of sodium form sodium chlorplatinate, $Na_2PtCl_6 \cdot 6H_2O$, a quite soluble salt crystallizing in yellow triclinic prisms having an extinction angle of about 22°.

It is seldom that well-formed, distinct crystals can be obtained, the result being generally an aggregate of imperfectly developed crystals (see Fig. 28).

The salt is soluble in even strong alcohol, so that the addition of this reagent will not cause the separation of crystals, save in that evaporation is hastened. The best plan is to allow the drop to evaporate spontaneously, and then examine

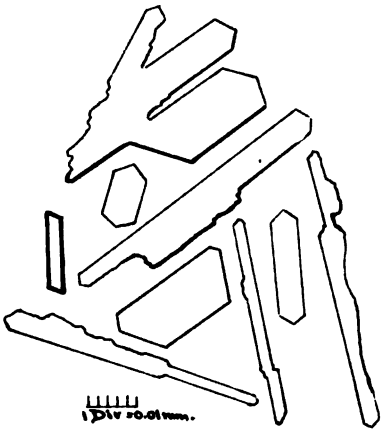

Fig. 28.

the residue with polarized light. In addition to the fact that the sodium chlorplatinate will be seen to give oblique extinction, this salt exhibits very brilliant colors, making it possible to detect small amounts in the midst of other material.

The chlorplatinates of potassium, rubidium, cesium, and ammonium are isometric. That of glucinum, which is also obtained when evaporation is practiced, is tetragonal. Lithium forms a very soluble chlorplatinate similiar to that of sodium.

Chlorplatinic acid is little employed for the detection of sodium except in connection with some other element. It is our most valuable reagent for potassium and for ammonium (q. v.). It is, therefore, possible in testing for these elements to obtain an indication of the presence of sodium at the same time.

VII. Picric Acid.

Sodium picrate crystallizes in masses of radiating, more or less curved and branched needles, when solutions in which this salt occurs are evaporated. The appearance is quite characteristic of sodium, provided the reaction is tried on pure salts, but when mixtures are examined the results are unsatisfactory.

Potassium and ammonium picrates are far less soluble in water, almost insoluble in cold alcohol, and tend to crystallize in more or less distinct, well-formed, needles or prisms belonging to the orthorhombic system (picric acid itself crystallizes in the orthorhombic system). These two salts differ quite markedly in appearance, and are distinctly different from sodium picrate.

The chief difficulty is that picric acid unites with a large number of elements, and many substances, to form crystalline compounds differing but little in appearance from the salts of the alkalies.

VIII. Cerous Sulphate.

In the absence of potassium, this reagent gives an exceedingly delicate test for sodium owing to the formation of a double sulphate of low solubility, to which the formula $Na_2SO_4 \cdot Ce_2(SO_4)_3 \cdot 2H_2O$ is generally ascribed. Unfortunately the neat lenticular crystals produced are so small that a magnification of several hundred diameters is required to bring them into evidence. For this reason the usefulness of the reaction is greatly restricted.

IX. Tartaric Acid.

This reagent, suggested by some workers in micro-chemical analysis as a means of distinguishing between sodium and potassium, should not properly be included in the list of tests, since the solubility of sodium tartrate is such that this salt will probably be one of the last tartrates to separate from a solution of a

mixture of elements to which tartaric acid has been added. For this reason sodium tartrate becomes one of our useful reagents.

Tartaric acid, added to *very* concentrated neutral solutions of simple salts of sodium, precipitates an acid tartrate of sodium in the form of acicular prisms, usually grouped in radiating clusters.

The normal and acid tartrates of the other alkalies are far less soluble, form larger and bulkier prisms, and exhibit but little tendency toward the formation of clusters.

An almost insurmountable difficulty to the employment of tartaric acid for the detection of the alkalies in mixtures, aside from the fact that many elements give precipitates, is that double tartrates of the alkalies are very readily formed, which are apt to seriously complicate matters and lead to error.

X. Conversion into Double Sulphates, etc.

For those who are expert in the determination of the optical properties of crystals, and in the recognition of crystallographic systems and forms, this method is certainly a very convenient and elegant one. Its usefulness is somewhat restricted, however, and it is seldom applied save for the detection of the common rock-forming elements.

The material to be tested is converted into sulphates, and a solution of these salts is allowed to crystallize spontaneously. The residue, consisting of simple and double sulphates, is then studied, and from the form and optical properties of the crystals, it is often possible to decide what bases are present. It is seldom that the average worker in micro-chemical analysis acquires the experience necessary to successfully interpret the results of such an examination.

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Chemical Laboratory, Cornell University.

The Lesion in Actinomycosis with a Few New Stains for the Actinomyces.

Text-books generally recommend carbol fuchsin followed by picric acid; anilin gentian violet, and Gram's solution; and hæmatoxylin by Weigert's method.

A couple more stains will not come amiss: Hæmatoxylin (Harris) is a very good stain for the organism, and when this stain is left on the preparation from five to fifteen minutes, according to the strength of the stain, and then washed in water and followed by a saturated alcoholic solution of picric acid for a moment, a beautiful picture results. Clearing can be effected either with oil of cloves, cedar oil, or oil origanum.

The ray forms of the organism can be distinctly made out, their apparently homogeneous though granular centre differing decidedly from the really homogeneous club, or periphery of the ray. Within the centre can usually be seen several entangled polymorphonuclear leucocytes. The situation of these ray forms is generally within an area of small round cells. It is, however, separated from these cells by an apparently clear zone, very few cells being demonstrable, im-

mediately surrounding it. Sometimes a small, irregular or imperfect ray can be seen outside these areas, but generally they are within. These irregular or imperfect forms consist mostly of a large centre, irregularly oval, with very few short rays upon one side. These clubs, as they are more commonly called, are not nearly as tapering as some text-books picture; they are more blunt than really pointed. This apparently clear zone, above mentioned, contains a very delicate connective tissue, nearly a rectiform tissue, in which a few round cells and polymorphonuclear leucocytes are seen; each of these areas of round cells is itself distinctly, and more or less sharply, separated from the surrounding tissues. Sometimes, as mentioned previously, the polymorphonuclear leucocytes appear to be seen in the centre of the ray fungus. These cells do not really extend into the fungus itself, but through the winding irregular arrangement of the fungus give this appearance. The cells making up the lesions of the disease are for the most part small round cells. Together with these are seen numerous polymorphonuclear leucocytes, and some very large mono-nuclear cells, averaging from 9 to 10 μ, the nucleus usually eccentric and the protoplasm staining faintly, evidently epitheliod cells.

The general structure or background of the lesion in general appears under the low power of the microscope to be made up of fibrin, entangled in the meshes of which are a few round cells and polymorphonuclear leucocytes; under higher amplification, however, this fibrinous appearing structure is seen to be made up of delicate, newly forming connective tissue, a large number of branched connective tissue cells, and spindle-shaped cells corresponding to fibroblasts. Numerous blood vessels of small calibre are also seen. Very little fibrin is demonstrable. Another very pretty stain is one obtained by using polychrome methylen blue (Unna). This stain is left on from fifteen minutes to twenty four hours, the excess of stain drained off, and styron applied. Styron possesses the property of bleaching and clearing, and if left on too long will completely decolorize the specimen.

By placing the specimen under the microscope from time to time with the styron upon it (when bleaching has commenced) excessive bleaching can be prevented. After the styron has bleached sufficiently it is washed thoroughly with cedar oil, and the specimen cleared with the same reagent, and mounted in balsam. The fungus stains blue by this method, the connective tissue pinkish, and the cells blue. Carbol tolindin blue (Harris) is also a very good stain, and when the preparation is counterstained with eosin, a very good, well differentiated specimen results. In staining with the latter stain no mucinoblasts nor plasma cells were demonstrable; not with any stain used were giant cells demonstrable. A two per cent. aqueous solution of gentian violet (without the addition of anilin oil) and afterwards treated with Gram's solution and decolorized with anilin oil, makes a very good stain also. The areas of round cells, with the ray fungus, stand out very prominently from the rest of the decolorized specimen; or, counterstained with eosin, a very good red or pinkish background results. The lesion is considered under the head of chronic infections, granulomata, which are characterized by small round cells, epitheliod cells, and giant cells. In those specimens which I have examined, most of the lesions were made up of small,

round cells. Together with these small, round cells were quite a number of polymorphonuclear leucocytes, while a few epitheliod cells, but no giant cells, were encountered.

The newly forming connective tissue is more or less honeycombed in appearance, and resembling in some cases adipose tissue very closely. In none of the sections was caseation demonstrable. Giant cells are peculiarly absent; of course, too, in all cases of tuberculosis giant cells are not always seen, so it may be that in other cases of actinomycosis giant cells may be singularly abundant. Mucinoblasts, or Mast cells, or plasma cells, are nearly always present in a chronic inflammatory condition, but here again, in the specimens gone over, none of either were demonstrable.

Again, a word about the fungus: hyphæ were very seldom seen; not nearly so abundant as one would likely imagine them to be. This was the case both in fresh and stained preparations, the ray forms by far predominated. In some of the specimens small, oval, apparently homogeneous bodies were seen lying near the ray fungus. These may have been spore forms of the organisms. They were about 5 microns in their greatest diameter, and 2 microns in its shortest diameter.

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Devices for Exhibition of Objects in the Teaching Museum.

The museum is a not inconsiderable factor in the success of any biological department. There are three kinds of museums: first, those which have popular amusement and instruction for their object; second, the teaching museum, which forms a part of the appliances of a department of biology in high schools, colleges, or universities; and third, the investigator's museum for the gathering, care, and storage of biological materials. Not all of these types come inside of the range of all institutions of learning, but the second most assuredly does. Such a museum is effective in proportion as it contains whole specimens or preparations of parts of them, covering the ground gone over by the students, and of related objects, besides models, charts, and the other more usual paraphernalia which are generally considered necessary to teaching and laboratory work. Every laboratory has much material waiting to be put up in some permanent form; how shall it be done? It is no intention at present to give general instructions in such a direction, but only to mention and show a few simple devices that are proving very useful in the biological department of Hamline University.

One of these is the glass box designed by Mr. C. C. Tyrrell, a student assistant in the museum of Hamline University. This box is very useful for dry objects of almost any kind. It has the advantage over the ordinary tray of keeping the object from the dust, and over the ordinary glass-lidded box of presenting both sides of the object to view. It makes it possible to pass frail objects around, or leave them on the lecture table or in the laboratory, without danger to them. Almost any object that can be dried can be exhibited in them.

Some of the Hydrozoa and Polyzoa, like Sertularia, and others with chitinous skeleton, show the general habit of the colony as well in them as in fluids. They are very convenient for the more brittle kinds of echinoderms. A specimen like

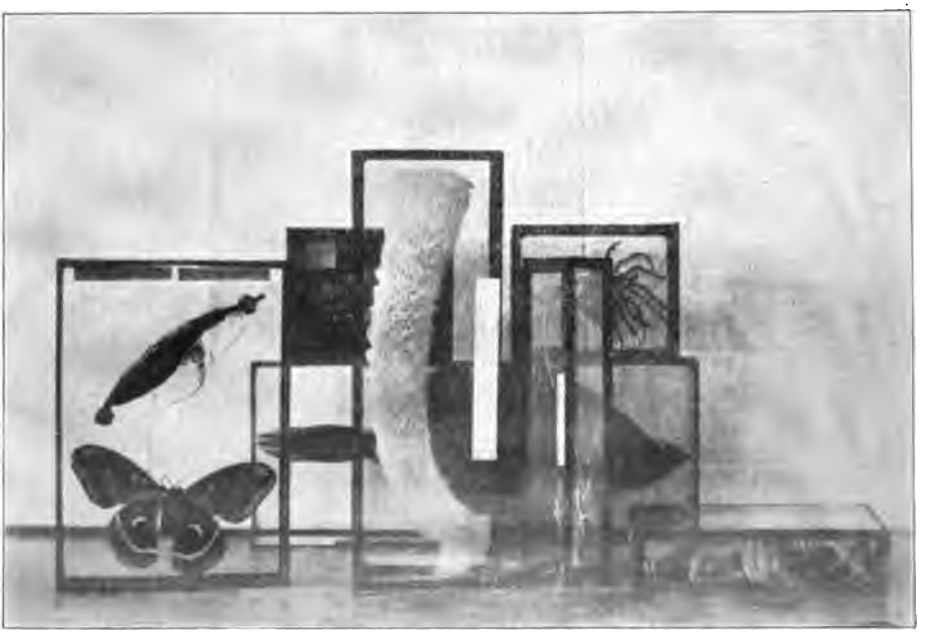

Figure 1.

the glass sponge is entirely safe, and yet generally accessible in one. They are very suitable for crustaceans and insects; for the latter they are better than the boxes in use, where the insect rests on cotton or plaster, with one surface entirely hidden.

The boxes are easily made, and are very inexpensive. The sides are first cut the full length of the box; then the ends are cut, and these are made shorter than the width the box is to be by the amount of the thickness of the glass of the sides. These sides are then fastened together (as shown in Fig. 2) by means of gummed paper (we use the strips sold for making photographic transparencies). The one placed inside is fitted snugly to the glass by pressure from a square block of wood. These strips must fit tightly and be glued to the glass firmly, as the strength of the box depends on this. After the sides and ends are finished, the bottom is put on over them; it is cut the full size of the box, and fastened on in the same way. Then the specimen is put in, and fastened by pieces of cork that are glued firmly to the glass on the bottom, and if necessary on the sides. The top is cut the full size of the box and is laid upon the sides and ends, and gummed to them by means of the strips. Thus the box is completely closed in, and the object cannot be taken out without

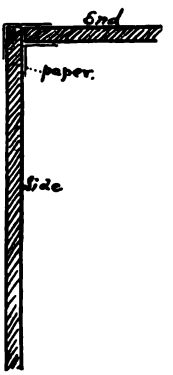

Figure 2.

breaking the seal. This makes the box dust proof. The precaution must be taken to have the object entirely dry before it is sealed up in the box, otherwise its moisture cannot escape and is likely to mould the object. I have not used these boxes outside of Minnesota, but they are entirely satisfactory in this relatively dry climate. It seems likely that they would be available for general use, but that needs further testing.

Figure 3 shows four other devices in use in our laboratory museum. The bird, a gull, has been prepared so as to combine the advantages of a skeleton and a stuffed specimen, and to show the wing and feet. Such a mode of mounting gives a much clearer idea of the mechanism of the wing than can be had by studying either the feathers or the bones separately. Next the gull, on the right, is a

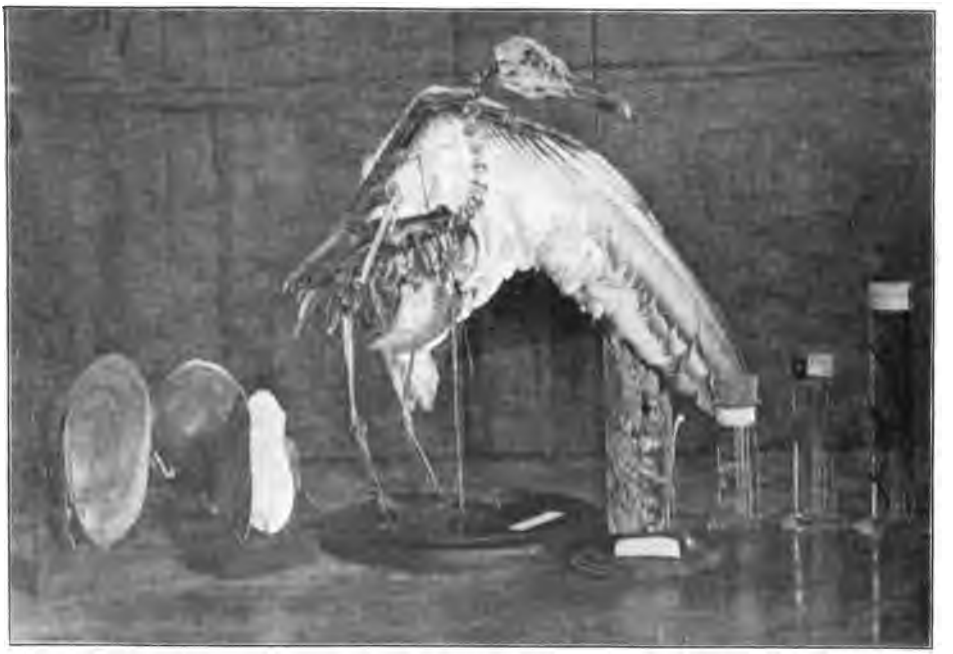

Figure 3.

piece of wood that has been bored by Teredo, and in the attached vial is a specimen, in alcohol, of the animal. On the right again are three tubes, made by the glass-ware manufacturers, to combine the advantages of a tall tubular jar for elongate objects and stability, the flange at the bottom making the tube entirely stable in spite of its height. Ground stoppers can be ordered for these tubes, or they can be sealed with corks, which, if they are boiled in paraffin and pushed down and covered with melted paraffin, withstand loss of alcohol by evaporation. The cork can be covered by the label. In the same picture, on the left, are shown some lamellibranch shells, that have been conveniently mounted by drilling a hole through each valve and bending a brass pin into the hole, and then driving the pin into a block which serves as a base for the specimen. Shells

mounted in this way show both sides of both valves, and can be placed in homologous positions, so as clearly to show the specific or other differences.

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Notes on the Preparation of Haematein Staining Solutions and on the Technique of Staining.

Up to a few years ago all formulæ for the preparation of hæmatoxylin solutions, especially those containing alum, ended with the following directions: "allow to stand in the light from eight to ten days before using." This was for the purpose of allowing the staining fluid to "ripen," as it is well known that freshly prepared solutions are of no use for staining.

This "ripening process" was found to be due to the oxidation of the contained hæmatoxylin and the formation of *hæmatein*, through the absorption of oxygen from the air. Paul Mayer and Unna found that this oxidation could be brought about immediately by the addition of a small quantity of hydrogen peroxide; Hansen, by the addition of potassium permanganate. We have hastened the process by passing air through the solution, using air compressed by the usual spray apparatus.

All hæmatoxylin solutions deteriorate in the course of time, the oxidation process continuing until precipitates form and the solution becomes colorless. Unna found that this over "ripening" could be delayed by the addition of a small quantity of sulphur. Paul Mayer used glycerin, and Gage, believing this to be due to the action of bacteria, sterilized his alum solution and then added chloral hydrate as a preservative. Owing to the investigations of Paul Mayer we are now in a position whereby *hæmatein* staining solutions can be quickly made, without the long "ripening" process.

Hæmatein, which Mayer uses in place of hæmatoxylin, comes in the form of dark greenish crystals or powder, and is freely soluble in alcohol and water. The commercial form is not always pure, and owing to this, *hæmateate of ammonia* has been recommended in the place of hæmatein. This salt is also found in commerce, but of doubtful purity. It can be readily made in the laboratory as follows: One gramme of hæmatoxylin crystals is dissolved, by the aid of heat, in 20 çc. of distilled water and filtered. To this solution 1 cc. of ammonium hydrate (sp. gr. 0.875) is added, and the dark purple fluid placed in a shallow porcelain dish, of such a size that the layer of fluid shall not exceed one-half a centimeter in depth. The dish is covered with filter paper, to exclude dust, and the solution allowed to evaporate at the room temperature. The hæmateate of ammonia about equals in weight the hæmatoxylin used. In the preparation of this salt no metal instruments should be used until the powder is absolutely dry.

Mayer gives formulæ for three different solutions of hæmatein as follows:

Hæmalum.—Dissolve 1 gm. of *hæmatein* or *hæmateate of ammonia* in 50 cc. of 90 per cent. alcohol, and add this to 1000 cc. of a 5 per cent. aqueous solution

of *potash alum*, filter, and add a crystal of thymol to prevent the formation of moulds. This fluid has a color resembling that of borax carmin. It may be used for staining in full strength, or it may be diluted with weak alum solution. In full strength it stains sections in about two minutes.

Acid Hæmalum.—This is prepared by adding two per cent. of hydric acetate to the above hæmalum solution. After staining, wash well in water to bring out the bluish tint of the nuclei. This solution is decidedly less diffuse in staining, and keeps better than the hæmalum.

Glycerin Hæmalum.—The above solutions of hæmatein do not keep well. To correct this, Mayer adds glycerin as a preservative. The solution is made as follows: Rub up 0.4 gm. of hæmatein in a mortar with a small quantity of glycerin; dissolve 5 gms. of potash alum, 70 cc. of distilled water, and add 30 cc. of glycerin. This mixture is gradually added to the hæmatein solution. This stain keeps well, but is somewhat slow in its staining.

During the last year we have been using *hæmatein* in place of hæmatoxylin with the most satisfactory results. The staining fluid we have used is one made after a combination of Mayer's and Gage's methods. Our solution is made as follows: A 5 per cent. solution of potash alum is made in distilled water and boiled, or what is better, placed in a steam sterilizer from one to one and a half hours. While this solution is warm, 1 per cent. of *hæmatein*, dissolved in a small quantity of alcohol, is added (it is our practice to keep a 1 per cent. alcoholic solution of hæmatein as a stock solution). After the fluid has cooled, add 2 gms. of chloral hydrate for each 100 cc. of the staining fluid. This stain keeps well, and in full strength stains sections in from two to three minutes. It may be used diluted with distilled water, when the staining requires a longer time.

Staining Technique.—Soon after the introduction of the sieve dishes of Steinach, we employed them in staining. These dishes are of glass, the bottoms being perforated with a number of holes. These holes are comparatively few in number, consequently the fluids do not drain away rapidly, also being of glass they soon become broken. For these sieve dishes we have substituted the ordinary tea strainers. These are made of fine meshed, tinned wire; they are of various sizes and shapes, and are cheap. In the use of these strainers we proceed as follows: The sections, in alcohol, are poured into one of these strainers, the alcohol draining away quickly. The sieve part of the strainer is then immersed in water contained in a cylindrical-shaped vessel, and of such a diameter that the rim of the strainer will rest on the top. The strainer is raised and lowered several times, so that the alcohol may be thoroughly removed from the sections. The strainer is then transferred to a vessel containing the staining fluid, then successively to two containing water, then to one containing strong alcohol, and finally to one containing eosin alcohol to complete the dehydration, and the staining with eosin.

The eosin alcohol used by us is prepared by the method of Sharp, and the eosin added to this in the proportion of one to fifteen hundred. By means of Sharp's method the ordinary alcohol is very much increased in strength, in many cases being brought up to 99.6 per cent. to 99.8 per cent. This alcohol is prepared as follows: Cupric sulphate is pulverized and heated at a temperature of

100° Centigrade until all the water of crystallization is driven off, and a white powder is the result. This powder, anhydrous cupric sulphate, is placed in a glass-stoppered bottle, until the bottle is about one-third full, and ordinary alcohol added. After standing for twenty-four hours, the surface of the copper will have become decidedly blue, from the absorption of the water from the alcohol. Test made at this time will show the alcohol to be over 99 per cent. Fresh alcohol is added, from time to time, until all of the copper has become blue in color, now it is no longer of any use for dehydration. The supernatent alcohol is now poured off, and the bottle placed in a hot air sterilizer at a temperature of 100° C., until the cupric sulphate is again rendered anhydrous.

The eosin is prepared by the method of Fisher. The eosins of commerce vary very much in their staining properties, so that the same results are hardly ever obtained with two different samples. By the use of Fisher's method an eosin is obtained which gives almost constant results. Make a saturated solution in water with Grübler's water soluble eosin, and precipitate this solution with hydric chloride, adding a slight excess of the acid. Bring the precipitate on a filter, and wash with water until the filtrate begins to come away slightly tinged with the eosin. This indicates that all of the acid has been washed out. Allow the precipitate to dry ; powder, and preserve for use. The eosin prepared by this method is several shades lighter in color than the eosin of commerce. It is decidedly more selective in its staining, and gives a more transparent stain. It is quite freely soluble in alcohol, but slightly in water.

Personally, we have discontinued the use of eosin alcohol in our staining technique, adding the eosin to the clearing oil. We keep a saturated alcoholic solution of the above eosin in stock, and add say 5 to 10 drops of this to the oil ; as the staining of the oil becomes weak this addition of the alcoholic eosin is repeated. In our experience, this gives a clearer and more selective stain.

For clearing purposes we now use a mixture of the French white oil of thyme and oil of origanum *cretici*. This mixture acts as well as the pure oil of origanum, and is decidedly less expensive. We mix one part of oil of origanum cretici with three parts of the oil of thyme, add a considerable quantity of powdered chalk, and after twenty-four hours filter. Many of the oils used for clearing have a more or less acid reaction, which in many instances will bleach out the hæmatein stain. The treatment of the oil with chalk corrects this acidity.

George C. Freeborn, M. D.

Instructor in Normal Histology, Columbia University.

Arrangement of Serial Sections.

There is an unfortunate lack of uniformity in the method of arranging serial sections for microscopical study. Some investigators arrange the ribbons continuously, i. e., the first section of the second row is placed immediately below the last one of the first row. Other workers prefer to arrange the sections like the words on a printed page. From this lack of uniformity there results no little inconvenience when the microscopist, accustomed to the one, attempts to study sections arranged according to the other method. This is especially confusing

in the case of material prepared for class use. Since uniformity is clearly desirable, which arrangement is to be preferred?

I have heard but two reasons advanced by the adherents of the second method. Of these the common one is that such an arrangement is the more natural for study. This is clearly only a personal matter. Either method must be learned, and there is no *a priori* reason why it should be more natural to move a slide two inches rather than a sixth of an inch in order to pass from one row to another. A much more valid argument is that the method obviates the turning of the sections, and is, therefore, the easier. This is true, but the end to be sought is convenience in study, not in preparation. Moreover, in practice the turning of the sections resolves itself merely into a matter of habit.

On the other hand, the conveniences of the continuous arrangement are great. These are the more obvious when it comes to the study of minute sections, where many rows are crowded on a slide. Then a slight movement of the slide quickly and accurately locates the desired section. In any case the method presents decided advantages, and no one who has ever used it will willingly abandon it.

WILLIAM A. RILEY.
Cornell University.

A Method of Making Biology Wall-Charts.

No biological laboratory is complete without charts for illustrating lectures, and as aids to students in carrying out their work. The statement of a simple fact may mean much, but it will have double the meaning and interest if the instructor can point to a well executed illustration upon a chart.

The instructor in a small college or high school often finds his work hampered by the lack of charts, since an adequate supply is beyond his limited appropriations. For this reason it may be of interest for teachers of biology to know that very serviceable charts can be produced at a very small cost.

The method is as follows: The chart material is a good grade of printed muslin, which costs five to six cents per yard (care should be taken to select a quality that is closely woven, and one that possesses a smooth surface, because the

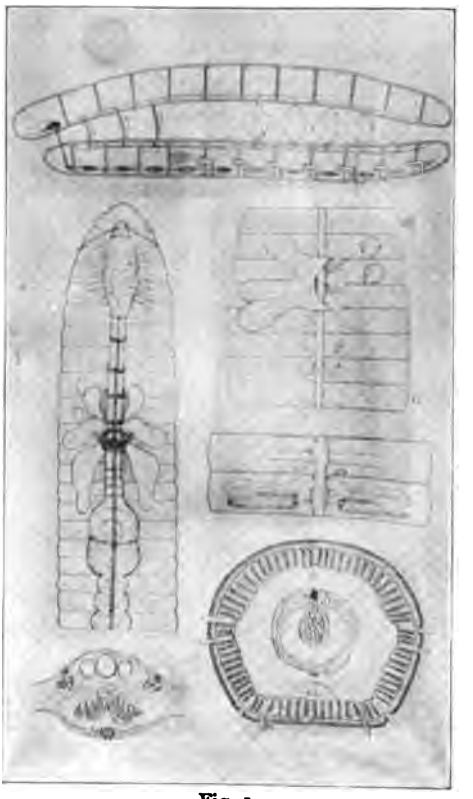

Fig. 1.

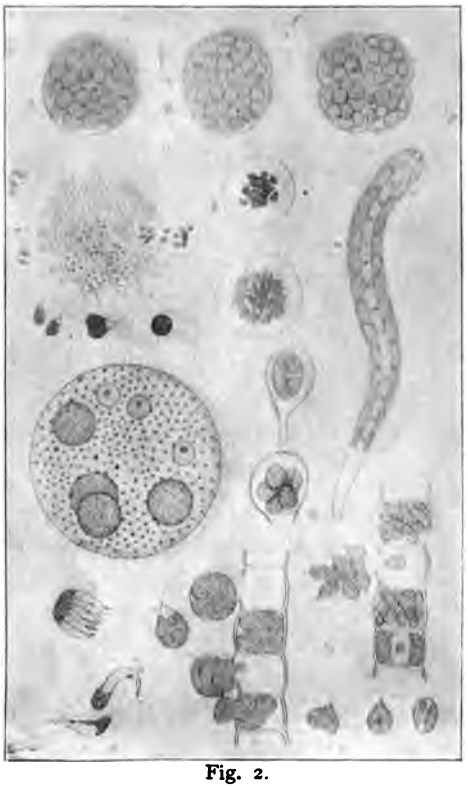

Fig. 2.

loose, open quality allows the ink to spread). The muslin should be cut into lengths of five or six feet, and a plain pine roller tacked at the bottom end, and a curtain stick at the other end. A small screw-eye in the middle of the curtain stick will serve to hang the chart to the wall.

The chart should then be hung on the wall in such a position as to be available for work. The outlines of the illustrations can be made with a lead pencil, and then traced with India ink and a shading-pen. In all of my outline work I have used Higgins' India ink and a number 0 pen. The chart illustrating the structure of the earthworm (Fig. 1) is nearly all plain outline work, with a minimum amount of shading. When colored effects are desired, the colored inks manufactured by Higgins & Company give excellent results. For some of the coarser detail work a number 2 shading-pen can be used to good advantage.

Fig. 2 is a chart illustrating Volvox, etc. This chart shows that the ordinary methods of India ink drawing may be used upon printer's muslin with a shading-pen.

By this method an instructor can produce a very valuable set of charts with a comparatively small outlay.

F. D. Heald.
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Canada Balsam for Ringing Slides.

In a late number of the Journal of Applied Microscopy I noticed a description of a method of using Canada balsam for retaining specimens in glycerin under cover-slips. After using asphaltum for a number of years in our laboratory for ringing specimens in glycerin and gum glycerin, and getting very poor results as to permanency of specimens, we have experimented with Canada balsam, using it in the same way and for the same purpose as asphaltum. The slides, with round cover-slips covering the specimen in glycerin, are placed on an ordinary ringing wheel, and the balsam applied with a small brush. The balsam should be comparatively thick, and applied freely at the edge of the cover-slip. After a number of months the specimens are found to be perfectly sealed, and the balsam smooth, firm, and hard.

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Synthetic Alcohol as a Fixing Agent for Tissues.

I recently became possessed of a product of chemical skill which aroused in me considerable interest and enthusiasm, namely, synthetic alcohol.

I was informed that the manufacturers of this alcohol claim it to be equal in every respect to the absolute alcohol made by distillation from grain, and that the cost of the synthetic product would be materially less than that of ordinary absolute alcohol, on account of there being no tax upon the laboratory product.

Provided the above claims are valid, here is a boon to laboratory workers, for, alas, many of us are hampered by limited appropriations and must use expensive materials accordingly.

Synthetic alcohol is a clear fluid resembling the distilled alcohol, except that its odor is not as penetrating. It has a warm, burning taste, evaporates rapidly, and burns with a blue flame and no smoke. Celloidin is readily dissolved by it.

Tissues from a case of spindle-cell sarcoma of the knee were, immediately after amputation of the leg, cut with a sharp knife into cubes about 5mm. in diameter and placed in the following fixing agents:

Formalin 10 per cent.—In twenty-four hours slightly swollen, spongy in character, though fairly well hardened and elastic. At the end of forty-eight hours, no change.

Absolute Alcohol.—In twenty-four hours somewhat contracted, quite firm and elastic. At end of forty-eight hours well hardened.

Synthetic Alcohol.—In twenty-four hours seems to be slightly contracted and is quite firm. After forty-eight hours more firm, being quite as hard and of the same color as the pieces in distilled alcohol.

Blocks of these tissues from each of the fixing agents were cut by the celloidin method under 95 per cent. alcohol.

Sections were stained in Böhmer's hæmatoxylin and eosin and also in safranin and picric acid.

Fixation in the formalin sections was poor. The sections fixed in the distilled alcohol and synthetic alcohol were identical.

In each the fixation seems perfect.

Mytotic figures are numerous and are finely brought out, the spindles and attraction spheres showing beautifully, especially in the safranin specimens.

Blood is well fixed *in situ* in the vessels.

The tissue from the synthetic alcohol stains quite as well as that fixed in the absolute grain alcohol, and the red blood cells even better.

Blocks of tissue fixed in absolute grain alcohol and others from the synthetic alcohol were sectioned by the paraffin method with like results.

In a series of thirty necropsies synthetic alcohol was used exclusively as a fixing agent, and with the most flattering results.

The microscopic pictures of tissue thus fixed have a brilliancy which is not equalled by any other method.

So pleased have I become with this agent, that it is now used in my laboratory in all routine work, in fact, in every case in which a special method, such as a Golgi stain, does not demand a different fixative, and I have yet to be disappointed in its performance.

T. E. Oertel.

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Journal of Applied Microscopy.

L. B. ELLIOTT, EDITOR.

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The majority of our subscribers dislike to have their files broken in case they fail to remit at the expiration of their paid subscription. We therefore assume that no interruption in the series is desired, unless notice to discontinue is sent.

THE tendency of scientific societies, as in every other line of human activity, has been toward specialization. More and more closely have the lines which limit the scope of a given society been drawn, and new societies have been instituted to take up the work thus excluded, until the category of active societies is now a long one. A necessary result of this specialization is the isolation, to a great degree, of the workers in one field from the great mass of scientific work as it advances in other lines. To be sure, scientific publications abound, but no worker has the time or even the opportunity of searching them for the information he needs.

It is proposed to meet this difficulty by compiling an international catalogue of scientific literature, which shall unite the work of societies and individuals the world over into a series of publications, which shall carry to the individual worker the very information he seeks: that of the work done on the subject in which he himself is engaged. It is, of course, impossible to determine the amount or character of work an individual might do without the aid of a society; it is, however, certain that much of the work done by individuals who have attained prominence in the scientific world has been made possible through the support of some society. The society offers opportunities for discussion; brings together men of similar and dissimilar ideas, and substitutes collective and organized action for isolated individual effort. It affords means of publication, organizes research, records discoveries, stimulates invention, and assists students by providing a common meeting place, a center of action. Every scientific discoverer desires immediate publication of his work; every industrial inventor requires publication in order that he may secure the natural profits of his invention. A society systematizes and arranges the science or study which is its subject matter.

The present condition of science is certainly due to the organized efforts of scientific societies. They secure public recognition for science and those who pursue it; they prevent overlapping; serve to deter different men from working on the same lines; and they bring influence to bear on the public and on the government.

A society is only a collection of individuals, and the work of the society is the work of the individuals composing it. Any individual is less powerful by himself than when he is associated with others seeking the same object. It is, therefore, the individual to whom all of these advantages of the single society accrue, and who will profit by the international catalogue of scientific literature.

It is a significant fact that the societies of the United States have responded so generously to the call for subscriptions to the catalogue. One-third more subscriptions have been placed in the United States than in any other country. This is certainly encouraging to the students of this country, for it indicates a distribution of the work to such an extent as to be readily accessible to most investigators here; it also indicates that the societies of the United States will hold a prominent place in the world society of which the international catalogue is to be the publication.

The student pursuing a definite line of work cannot, therefore, forego the advantages derived from being identified with some society, recognized for its success in the work it presumes to embrace.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to Charles J. Chamberlain, University of Chicago, Chicago, Ill.

REVIEWS.

Devaux, M. H. Recherches sur les lenticelles; étude sur les conditions physiologiques de l'accroissement et de la différenciation de la cellule et des tissus. Ann. Sci. Nat. Bot., VIII, **12**: 1–240, pls. 1–6; 1900.

This is the most exhaustive work on lenticels which we have ever met. After a brief historical resumé the author gives the account of his own investigations, which deal with both the morphology and the physiology of the organ in question. The general scope of the work may be inferred from the titles of the chapters, which are as follows: Distribution and size; structure; origin; development; porosity; influence of external factors upon lenticels; internal influences; physiology and growth; nature of lenticels; function.

Lenticels are found in all the great groups of vascular plants. As to structure, two general types may be distinguished; in one the closing layers are few in number and consist of cells closely united, while in the other the layers are more numerous, and the cells composing them are loosely united. In regard to origin there are also two categories; primary lenticels, which are formed early at a point determined by a stoma, a root, or a bud, and secondary lenticels, which are formed later, and at a point not determined by an organ. Most lenticels are porous, but some are completely closed at all seasons. The degree of porosity varies with the season and with external conditions, and lenticel transpiration varies correspondingly.

Lenticels are defined as small, limited regions of superficial parenchyma, undergoing continual proliferation and development, capable of hypertrophy and cicatrization, according to conditions of external and internal humidity. They adapt themselves continually to these conditions. C. J. C.

Bower, F. O. Studies in the Morphology of Spore-producing Members. Phil. Trans. Roy. Soc. B. **192**: 29–138, pls. 2–7, 1899.

This is the fourth paper of a series dealing with this subject, the previous papers having dealt with the Lycopodineæ (published in 1894), Ophioglossaceæ (1896), and Marattiaceæ (1897). The present paper deals with the homosporous leptosporangiate ferns. Excluding Isœtes and the Ophioglossaceæ, which he does not regard as Filicales, Professor Bower would divide the homosporous Filicales into three sub-orders: *Simplices*, *Gradatæ*, and *Mixtæ*.

In the *Simplices*, the sporangia arise simultaneously upon a receptacle which may be slightly sunken, flat, or slightly projecting. The sporangia are relatively large, sessile, and the spores are numerous (128 to 7000). The annulus, when present, is oblique. This sub-order includes the Marattiaceæ, Osmundaceæ, Schizeaceæ, Gleicheniaceæ, and Matonineæ.

In the *Gradatæ*, the sporangia are born in basipetal succession upon a more

or less elongated receptacle. The sporangia are smaller, and the number of spores is usually sixty-four. This sub-order includes the Loxsomaceæ, Hymenophyllaceæ, Cyatheaceæ, Dicksonieæ (exclusive of Patania, Woodsia, Hypoderris, and Deparia), and Dennstædtünæ.

In the *Mixtæ*, sporangia of various ages are intermixed, and are borne upon a sunken, flat, or slightly projecting receptacle. The sporangia are rather small, and the number of spores is sixty-four or less. This sub-order includes the Davallieæ (exclusive of Microlepia), Lindsayæ, Pterideæ, and other Polypodiaceæ, together with Woodsia, Hypoderris, and Deparia.

The terms Eusporangiatæ and Leptosporangiatæ, while not used to indicate taxonomic divisions, are still employed in description. A rather full review (to which the present reviewer is somewhat indebted) of this important work appeared in the *Botanical Gazette* for June, 1900. C. J. C.

Murrill, W. A. The Development of the Archegonium and Fertilization in the Hemlock Spruce (Tsuga canadensis, Carr). Annals of Botany, **14**: 583–607, pls. 31–32, 1900.

Material for this work was collected during three seasons from a thrifty tree near the campus of Cornell University. The principal results are the following: Pollination occurs about the middle of May, and two weeks later the archegonium rudiments appear; two weeks after this the ventral canal cell is cut off, and fertilization takes place five days later, so that the interval between pollination and fertilization is less than five weeks, a very short time as compared with *Pinus*, in which the interval is more than a year.

There are usually two cells in the neck of the archegonium, but the number varies from one to four. The passage of the nuclei from the jacket-cells into the egg, as described by Arnoldi, could not be confirmed, although the writer is not convinced that such a passage may not occur. In the mitosis which separates the ventral canal cell from the egg, a dense fibrous mass appears at the lower pole of the nucleus, and from this the lower portion of the spindle arises; the upper portion appears later, and is not so conspicuous in its development.

It is interesting to note that one of the sperm nuclei has twice as great a diameter as the other. This larger nucleus, a short time after it enters the egg, slips out from its cell and comes into contact with the egg nucleus. Each of the sex nuclei, as has been described by others, forms a spirem, but when the spirem segments, the chromosomes become mingled indiscriminately near the center of the spindle. Woycicki, who studied *Larix dahurica*, but whose paper may have been too late for reference, was inclined to think that the chromosomes of the two sex nuclei might remain distinct.

Twelve chromosomes were counted both in the egg nucleus and in the sperm nucleus. C. J. C.

Wiegand, K. M. The Development of the Embryo-sac in Some Monocotyledonous Plants. Bot. Gaz. **30**: 25–47, pls. 6–7, 1900.

The plants described in this paper are *Convallaria majalis L.*, *Potamogeton foliosus Raf.*, and *Canna indica L.*

In *Convallaria* and *Canna* the development of the embryo-sac presents no very exceptional features. It is of interest to note that in *Canna* the number of chromosomes in vegetative divisions is only six, and when passing to the poles

at the heterotypic division, there are still only six, but in the next division only three appear, the smallest number yet observed in a seed plant.

The description of the development of the embryo-sac in *Potamogeton* differs in several regards from anything hitherto published. Four nuclei are formed in the functional megaspore, and the pair at the upper end of the sac are at once inclosed by a wall; from these develop the two synergids and the egg; from one of the other pair develop the three antipodal, while the other divides, forming a fourth antipodal and a polar nucleus. This polar nucleus becomes the endosperm nucleus without fusion. A method of development so different from the usual sequence in Angiosperms would seem to the reviewer to need further confirmation, especially since the beautiful plates, which are evidently very accurately drawn, are capable of a less unusual interpretation. C. J. C.

Wojcicki, Z. Die Befruchtung bei den Coniferen (in Russian, Warsau, 1900). Reviewed in Bot. Zeit. **58**: 39, 1900, and in J. R. M. S., August, 1900.

To the cytologist, the chief interest in this paper lies in the fact that the author believes that *Larix dahurica* furnishes evidence that the paternal and maternal chromatin remain distinct and do not fuse. This supports observations made some time ago in an article on "Oögenesis in *Pinus laricio* Poir," by the reviewer, in which he states that the two chromatin masses, in the spirem stage, are visible within the original limits of the egg nucleus. Similar observations have been made by zoölogists, but *Larix dahurica* and *Pinus laricio* are the only cases yet described by botanists.

C. J. C.

CYTOLOGY, EMBRYOLOGY, AND MICROSCOPICAL METHODS.

AGNES M. CLAYPOLE.

Separates of papers and books on animal biology should be sent for review to
Agnes M. Claypole, Sage College,
Ithaca, N. Y.

CURRENT LITERATURE.

Ward, R. H. Library Expedients in Microscopy. Indexing, cataloguing, preparing, and arranging literature and slides. Transactions of Am. Micro. Soc. XXI.

This paper will be of great interest and assistance to those in difficulty, as to the most practical and advantageous method of handling the library, be it general or special in character. The author advocates the Decimal System, and under the headings above indicated discusses the advantages pertaining thereto. The advantages of indexing as a library expedient are obvious, universally known, and almost entirely neglected. The owner of a library who wishes to add to its usefulness ought to incorporate with the subject catalogue of his volumes, index references to such chapters, sections of passages, large or small, if not adequately included in the title of the volumes, as he may reasonably expect to wish to refer to, or be reminded of in the future.

A much more available, and, where extensive work of the kind is done,

almost indispensable, method, is to write upon cards of suitable size, short extracts or hints, important fragmentary notes or memoranda of personal observations, suggestions, or any such information likely to be required for future use, and classify these cards into a systematic card catalogue. Microscopical slides may be indexed and catalogued in a similar manner. Cards 25 x 75 mm. are amply sufficient in size, and if not too numerous, may be most conveniently distributed in their proper places among the slides in the object cabinet.

In building up a library, a great mass of mixed material in the form of magazines, reports, and various publications, comes to hand, in which there are portions of permanent value. If these old numbers are laid aside on the shelves for future use, the useful portions soon become buried in the great mass of worthless material, and are lost unless promptly and thoroughly catalogued by cards, and then the result is so cumbersome that the effort is soon abandoned. Instead of becoming thus burdened with so much useless material, take the numbers to pieces, glean out all that is of value, and in place of a cartload of worthless rubbish, there will remain a handful, more or less, that will be valuable. The separate papers thus obtained may be catalogued and filed away with other material on the same or similar subjects.

It is probably the general belief and experience that unbound literature is a nuisance, and great quantities of it are daily thrown away. If properly handled it is the only literature of permanent value that is not more or less a nuisance. Authors' separates or reprints of valuable articles on definite subjects, that can be handled or classified independently, are the ideal literature of our day, and the more other things that can be got into the same state of utility, the better. If only a few things of special importance are to be preserved, those of all sizes, from small clippings or memoranda to octavo pamphlets, can best be distributed by subjects into stout manila envelopes, and these properly classified between the books of the library, taking care to use envelopes slightly taller than the adjacent books, in order that they be not lost from sight between them; while quartos and larger would be piled horizontally at the ends of some shelves. Pamphlet cases, often used in larger collections, are clumsy and waste much room; are awkward to open, empty, and repack, unless made to open with a hinge motion at the back instead of a removable cover; are costly if of good quality and in large quantities, and preserve the contents in poor shape, by reason of the frail papers settling down unless some troublesome arrangement or apparatus be adopted to keep the boxes always stuffed full, or the contents pressed firmly against one side. For large collections the pigeon-hole method seems incomparable. The pamphlets of every kind, including the envelopes of small clippings or notes, are most perfectly preserved and most rapidly handled, and the space appropriated is most completely utilized.

Ordinary book-cases will be found a convenient receptacle. For a beginning a few shelves will suffice; the shelves should be set about three inches apart, and they should be at least twelve inches wide, which will hold folios lying lengthwise and smaller sizes crosswise. Of course every file has on the edge of the shelf beneath it a label announcing its subject and index number, and as these numbers follow each other in regular series throughout the collection, the

whole is delightfully simple, sensible, and available, whether it contains a hundred entries or a thousand.

Books, pamphlets, slides, and their catalogues, may be arranged either with or without classification. In serial arrangement, without classification, they are numbered and permanently located in regular order as required. This may be pursued with slides also. It is, however, not the best method; every private owner of literature or slides should, for pleasure of handling and for educational effect, have his collection classified in the most rational manner, so that the whole will present itself to the eye and mind as a harmonious whole, each section of it presenting, as far as possible, all that he has at command in regard to its particular subject, and standing adjacent to those most nearly related to itself. Classification by size, color, or elegance of binding are methods used only in ornamental libraries. Equally artificial, and only somewhat less unsatisfying, is the venerable alphabetical classification. This should be used as little as possible and as a last resort, in small groups, after a rational subdivision has been carried as far as practicable. As an artificial key it should be tolerated, not courted.

Alphabetical classification by authors, either separate or combined in same series with a subject classification, as a key, is a familiar library expedient, partly natural but largely artificial. To the microscopist it may be chiefly useful as a check list of his library, showing which books of each author listed he possesses, and which are still desiderata. The only classification that commends itself to a philosophical mind is by subjects. The indispensable requisite is to have a convenient number, not too many, of convenient classes, conveniently grouped together, with a few great lines of thought running through them, and radiating out into a convenient number of branches that are capable of likewise branching without limit. This naturally groups together, throughout, that material which will most probably be thought of and studied together, and the location of the material will be naturally led to by the trains of thought occupying the mind at the time it is wanted. A collection thus managed may be kept always fresh and up to date. Practical duplicates may be weeded out whenever desired, obsolete pieces may be thrown out, or retained for historical purposes, new material may be added at all times and to any extent, without trouble or confusion.

For the classification of slides, the system is not only peculiarly applicable, but incomparable, in addition to the great and decisive advantage of having the slides bear the same index numbers as the corresponding literature. In fact, the whole scope and utility of the system only become obvious when the same numbers are applied, and serve as a clue, not only to books, pamphlets, clippings, and slides, but likewise to the related notes, lecture MSS., diagrams, lantern slides, and illustrative specimens or aids of various kinds.

The author appends a very complete synopsis of the section *Microscopy*. The plan of the system may, however, be indicated by the following outline, which embraces only the general classes, and a brief key to one branch:

CLASSES OF THE DECIMAL SYSTEM.

0. General.	4. Philology.	7. Fine Arts.
1. Philosophy.	5. Natural Science.	8. Literature.
2. Religion.	6. Useful Arts.	9. History.
3. Sociology.		

KEY TO THE AMPLIFIED METHOD IN MICROSCOPY.

5 Natural Science.
57 Biology.
578 Microscopy.
578.1 Apparatus.
578.4 Accessories.
578.42 Micrometry.
578.429 Standards.
578.5 The Microscope in Science.
.55 In Geology.
.552 Micro-Petrography.
.552.2 Volcanic rocks.
.552.22 Volcanic ashes, etc.
.6 Economic Microscopy.
.61 The Microscope in Medicine (in broadest sense).
.614 In Sanitation.
.614.3 Study of Adulterations, etc.
.614.32 Milk and its Products.
.614.325 Butter and its Imitations.

Ex.: Discussion of the Am. Mic. Soc.'s standard cm. is	578.429
Verified copies of its rulings, on glass or metal slides,	.429
A drawer of Rock sections, or any literature concerning them,	:552
Oleomargarine specimens, or related literature,	:614.325
In using full tables the last item would have an adjacent number of its own,	:614.326.

C. W. J.

CURRENT BACTERIOLOGICAL LITERATURE.

H. W. Conn.

Separates of papers and books on bacteriology should be sent for review to H. W. Conn, Wesleyan University, Middletown, Conn.

Celli. Beitrag zur Erkentniss der Malaria-epidemiologie vom neuesten ätiologischen Standpunkte aus. Cent. f. Bak. u. Par. I. XXVIII, p. 530, 1900.

Studying the distribution of malaria in Italy, Celli finds it widely scattered, even in the valleys of the Alps. He finds the occurrence of double and triple malaria infections quite common. In one locality 28 per cent. of the cases are found to be double, and 6.3 per cent. triple infections. He points out a method of distinguishing relapsed (*recidiva*) cases from new cases of the disease. The former are somewhat difficult to distinguish, since they may appear in the spring at just the time when the new cases are appearing. The relapsed cases, however, are always milder than the new cases. Relapsed cases also contain the *gametes*, which are never found in the blood of new cases.

Grassi. Erster summarischer Bericht über die Versuch zur Verhütung der Malaria, angestellt in der Gegend von Paestum. Cent. f. Bak. u. Par. I. XXVIII, p. 535, 1900.

This paper gives an account of an extensive experiment carried on during the last summer in one of the most malarial districts of Italy. So badly infested is the locality, that it has been regarded as impossible to live there during the summer months. One hundred and four persons, including four children, were the subjects of the experiment. These persons lived the entire summer in this district, care being taken only to guard against mosquito bites by protecting themselves during the nights with netting. Three cases of malaria developed, and in regard to these there was evidence that the persons had suffered from the disease a short time before, and hence these attacks were relapses. Among the remaining one hundred and one there was not a sign of malarial infection. At the same time, statistics were collected among people living in the vicinity which showed an almost universal presence of malaria in all inhabitants of the district. Only the persons protected by netting were free from the disease. The genus of mosquito, *Anopheles*, was found in great abundance in this swamp.

Abba and Rondelli. Weitere behufs Disinfektion von Wohnräumen mit dem Flügge'schen und dem Schering'schen formogenen Apparat ausgeführte Versuche. Cent. f. Bak. u, Par. I. XXVIII, p. 377.

These authors have felt it necessary to enter a protest against the extension of the use of formaldehyde as a disinfectant in the sick room. Their work comprises numerous original investigations, together with a summary of the work hitherto carried on, and the conclusion they reach is extremely emphatic. They insist that formaldehyde has little use as a disinfectant. Their important conclusions are as follows:

Formaldehyde will disinfect surfaces of objects only when these are clean and polished. If the surfaces are covered with dust it has little value. The floor, mouldings and picture frames in rooms are not disinfected by formaldehyde, neither are the surfaces of upholstered furniture or mattresses, nor the wall of the room under ordinary circumstances. The power of formaldehyde to penetrate bedding is practically zero. It can never be relied upon as a disinfectant unless it is followed by the use of sublimate, and it is of practically no value unless it acts for at least ten hours. While the odor may be neutralized by ammonia, it frequently returns, and the room is for some time uninhabitable. For all these reasons formaldehyde is of no real value as a disinfectant. It is unreliable unless followed by sublimate, and if followed by sublimate, the formaldehyde is unnecessary.

Von Brunn. Alkoholdämpfe als Disinfektionsmittel. Cent. f. Bak. u. Par. I. XXVII. p. 309, 1900.

The author institutes a series of experiments upon the value of alcohol vapor as a means of disinfection. The methods employed consist in placing a spore-forming bacillus in a nearly closed vessel, and then in vaporizing alcohol of various grades, the vapor being allowed to fill the chamber and to come in contact with the bacilli. The results obtained are at first a little surprising. Vapor of ten per cent. alcohol, acting for thirty minutes, proved to be efficacious as a disinfectant. From this point the value increases to fifty per cent., and from fifty per cent. to seventy-five per cent. it

remains practically constant. Seventy-five per cent. alcohol has a maximum power of disinfection. Beyond seventy-five per cent. the value of the vapor becomes less, falling rapidly. The disinfecting power of ninety-five per cent. alcohol vapor is very much less than the vapor of ten per cent. Below ten per cent. the disinfecting power rises. The explanation of all this is simple. The ten per cent. alcohol contains so much water that it must be heated to a high temperature for vaporization, and the high heat destroys the bacteria quickly. The vapor of alcohol of a higher grade than seventy-five per cent. has no penetrating power for passing through the resisting walls of the spores, and hence its disinfecting power becomes rapidly less until it falls much below that of ten per cent. alcohol.

Pfuhl. Masseserkrankung nach Wurstgenuss. Zeit. f. Hygiene, 35, 265.

A company of eighty-one soldiers were taken with severe disturbance of the digestive organs, which was attributed to the consumption of a lot of sausage. The origin of the sausage was followed up, but it was found that no fault could be attached to its manufacture. Chemical study of the remains of the sausage showed no poisons, either metallic or organic, and a subcutaneous inoculation of animals with the material produced no injury. Feeding the sausage to animals, however, produced sickness and death in research animals. A bacteriological study revealed the presence of a *Proteus* species, which experiment showed to be the cause of the trouble. Animals fed with pure cultures of the Proteus showed the same sort of disturbances as the original cases. A careful series of experiments with this Proteus showed (1) that the sickness is due to a poison which is very closely bound with the bacilli, so as to be very difficult to separate, and (2) that the trouble cannot be regarded as a true infection, since there is no indication that the organisms multiply in the body of the animal suffering from the attack. The author points out that flesh may have every indication of being in proper condition, judging from taste, odor and appearance, and yet be capable of producing serious poisoning.

Ball. Versuche über eine Möglichkeit der Entstehung von Fleischvergiftungen. Hyg. Rund. X. 1017.

The author institutes a series of experiments to determine whether the poisonous nature of some samples of flesh may be attributed to infection by means of flies. He uses six species of flies and two species of bacteria, well known to be the cause of flesh poisoning (*Bacteria botulinus* and *Bacterium enteritidis sporogenes*). He placed the flies in a small vessel where they would feed upon flesh moistened with bouillon and containing the bacteria in question. Subsequently, the flies were removed and placed in sterile bouillon. The sterile bouillon was, afterward, in all cases found to be infected with the pathogenic organisms of the experiment. The conclusion is that flies may thus be a cause of the poisonous infection of flesh.

Minervini. Einige bakteriologische Untersuchungen über Luft und Wasser inmitten des Nord-Atlantischen Oceans. Zeit. f. Hygiene, 35, 165.

The author made a journey from Genoa to New York and back for the purpose of studying the bacteria in the air and water in mid-ocean. The methods used were the ordinary ones, except that, for the examination of the water, he was obliged, owing to lack of

facilities, to wait until he reached land before making any bacteriological examinations. The water, meantime, was kept very cold. His results showed that the air in mid-ocean is freer from micro-organisms than air on the land, but by no means germ free. The variety of organisms is also less than on the land, and the moulds are more common than bacteria. The same is true of rain water. In regard to sea water, he found the number of bacteria less than near the coast, but no less than is found a few miles from shore. The water contained from 8 to 140 organisms per cc. The variety of bacteria was small and moulds were less abundant than bacteria.

The Plague.—Anyone who is desirous of getting a concise outline of our present knowledge in regard to the plague, can do no better than to refer to the *British Medical Journal* of October 27, 1900. This number is chiefly taken up with a series of original articles upon various aspects of the plague. Some of the important topics discussed are the following: The Signs and Symptoms of the Plague; Notes on the Introduction of the Plague into Cardiff; A Case of Plague from a Clinical and Pathological Point of View; The Bacteriology of the Plague; Methods of Making Antitoxic and Preventive Fluids; Method of Using Haffkine's Prophylactic; Organization and Conduct of Plague Laboratories; Plague and Influenza: History and Distribution. H. W. CONN.

NOTES ON RECENT MINERALOGICAL LITERATURE.

ALFRED J. MOSES AND LEA MCI. LUQUER.

Books and reprints for review should be sent to Alfred J. Moses, Columbia University, New York, N. Y.

Schroeder van der Kolk, J. L. C. Konink. Akad. van Wetenshappen te Amsterdam. Sept. 29, 1900.

The ordinary streak, or color of the powder, obtained by rubbing a mineral upon unglazed porcelain, is for many so-called opaque minerals nearly black. If, however, this powder is reduced to finer grain by rubbing out the streak with a hard substance, such as a piece of quartz, the finer particles often transmit light and show color.

Examples are: *Green*, molybdenite, covellite, and bornite. *Violet*, chalcopyrite, and pentlandite. *Pale lilac brown*, pyrite, smaltite, and cobaltite. *Pale yellowish brown*, stibnite, jamesonite, hausmannite, and manganite. *Reddish brown*, stephanite, boulangerite, clausthalite, and bournonite. *Yellowish black*, galenite, enargite, chalcocite, berzelianite, argentite, berthierite, and anthracite. *Pale brownish gray*, magnetite, polianite, stannite, and corynite. *Pure gray*, graphite and pyrrhotite. It is recommended to compare always with the pure gray of graphite. A. J. M.

Mugge, O. Ueber Translationen und verwandte Erscheinungen in Krystallen. Neues Jahrb. f. Min. 1: 71–158, 1898.

The plasticity of crystals appears always to be conditioned by faces of displacement, T, along which displacement can take place in a definite direction, *t*. This displacement differs from the displace-

ment along gliding planes in that the movement does not cease with a definite displacement, and the portion moved has the same optical orientation as the rest. Translation striations, similar to the twin and combination striæ, are apt to form on all faces not in the zone of translation, *t*, and if, at the same time, there is a bending around a line *f* in *T* normal to *t*, the striæ will be bent except on faces in the zone of *f*. The existence of a capacity for translation is determined variously by pressure, bending, or torsion, and by percussion and pressure figures, and scratching. For instance, cleavages $\{010\}$ of anhydrite are frequently folded parallel $\dot{c}$, show blunt cracks on $\{100\}$, and neither folds nor cracks on $\{001\}$. This suggests $T=\{010\}$, $f=\dot{c}$, and $t=a$. By pressure this is confirmed, and, furthermore, if $\{010\}$ is scratched with a needle normal to $\dot{c}$ much powder is obtained, and the scratches appear feathered by side fissures, whereas, scratched parallel to $\dot{c}$, there is neither powdering or feathering. On $\{001\}$ scratching parallel to *a* develops a pearly lustre from the loosening of little plates parallel $\{001\}$, but scratching parallel *b* does not produce this. Similar phenomena are described for about 25 species. A. J. M.

Viola, C., and Kraus, E. H. Ueber Federowit. Zeit. f. Kryst. **33**: 36–38, 1900.

The name federoffite is given to a strongly pleochroic pyroxene with extinction angle $c : \mathrm{C} = 65°$ to $75°$ and $2 \vee < 50°$. It is widely distributed in the rock of the province of Rome, indeed it is claimed that all the eruptive rocks there found, whether leucitite, leucitephrite, or feldspar basalt, will contain this pyroxene. It occurs both as ground-mass and intrusions.

Zambonini, Ferruccio. Ueber den Pyroxen Lateums. Zeit. f. Kryst. **33**: 39–56.

Principally a record of crystal forms.

Klebs, R. Zeit. f. Kryst. **33**: 196, 1900.

A new fossil resin from Cedar Lake, Canada, and the sands of the Saskatchewan has been called "Cedarite." It occurs in small lumps, rarely as large as a walnut, and the original place of deposit is not known, but is thought to be cretaceous. A J. M.

Bowman, H. L. Beiträge zur Kentniss des Monazits. Zeit. f. Kryst. **33**: 113–126, 1900.

This is a study of the optical characters of monazites from several localities, with a tabulation and stereographic projection of all observed forms, and a bibliography. In all the crystals studied, the plane of the optic axes was perpendicular to *b* $\{010\}$, the acute bisectrix was in $\{010\}$ in the acute angle β, and the double refraction was positive. The axial angle varied, being larger in the American varieties than in those from the Alps. A. J. M.

Maschke, Otto, und Vater, Heinrich. Mikroskopische Studien über die Krystallisation des Gypses. Zeit. f. Kryst. **33**: 57–71, 1900.

Saturated solutions of pulverized gypsum in distilled water were placed in drops on object glasses and evaporated at ordinary temperature, to some were added eosin, to others hæmatoxylin, to others gum arabic, and to others gum arabic with eosin or hæmatoxylin. The crystals rarely exceeded 0.25 mm., and whether formed from pure water solutions

or after the additions, showed *without exception* the combination {010} {110} {101}. Nearly all lay with the clinopinacoid in contact with glass, rarely twinned or radiated. The crystals formed from solutions containing eosin, hæmatoxylin, or gum arabic showed a small portion of the foreign substance in molecular distribution on the directions of growth, about the dome face {101} *but not with respect to the other faces*; this led to the so-called "hour glass" structure, confirming Pelikaus' view that this structure may result from admixtures of non-isomorphous substances. The more foreign material had been absorbed, the greater was the relative size of the face {101}. In one case, with very intense hæmatoxylin coloring, the faces {101} feathered or frayed.

A. J. M.

NEWS AND NOTES.

Mr. James Mitchell Waltz offers the following method for the examination of sputum suspected of containing tubercle bacilli as the one which in his experience has proven most practical and satisfactory.

The spread is made as in other methods, dried by heat, stained by putting a drop on a cover-glass and holding it over a frame until the heat causes steam to be given off. Great care must be taken that the stain does not evaporate so as to dry or uncover any part of the spread, as that will ruin the specimen. Lay aside for three to five minutes. Then wash in running water, decolorize in 10 per cent. solution of H_2SO_4, dry, and mount in xylol balsam.

Do not use alcohol, as it causes the stain to fade from the bacilli.

For a counterstain, an aqueous solution of methyl blue is used. The formula followed in the preparation of this stain is:

Para Fuschin, - - - - - - - - - -	2 parts.
Alcohol, - - - - - - - - - - - -	q. s.
Cresol, - - - - - - - - - - - -	1 part.
Aqua dist., - - - - - -	to make 100 parts.

Dissolve the para-fuschin in the least possible amount of absolute alcohol, add one per cent. of cresol to the distilled water, and dissolve it, after which the cresol solution is added to the alcoholic solution to make 100 parts.

Bacteriological Diagnosis of Bubonic Plague.—At the commencement of a case of bubonic plague, i. e., at the period when there is only ganglionic congestion, in order to determine whether or not the plague microbe is present in this ganglionic congestion, make a puncture with Pravaz's syringe right into the lymphatic tissues, and extract therefrom some drops of fluid. To put the patient beyond danger of any possible reinfection by spread of germs, it is only necessary directly after the puncture is made, to inject a small quantity (about 5 cc.) of anti-plague serum into the very middle of the ganglion, or at a short distance from it. The ganglionic fluid thus extracted is placed immediately in

tubes of nutritive gelose, and in tubes of bouillon of beef or of veal at a temperature of 25° to 30° C. for a period of twenty-four hours. At the same time a small quantity should be spread out on glass slides colored with methylen blue or thionin. The direct examination of these slides will determine whether forms of short cocco-bacilli with transparent centers are present, and what relation these microbic forms bear to the leucocytes which always abound in the ganglionic fluid. If the microbes are free and very numerous, the prognosis is already serious; if the microbes are nearly all enclosed in polynuclear cells, it may be supposed that the case is non-malignant, and that the infection will remain localized.

The cultures furnish more exact evidence. On gelose, the number of colonies indicates the degree of gravity of the infection. In the meat bouillon the specific characteristics are more precise; the bouillon remains clear and transparent, and contains only some slight whitish clots floating on the surface, and which sink to the bottom of the tube at the least movement. If the bouillon is troubled it is quite certain that some other than the plague bacillus is present. In such cases, or even when the characters of the cultures seem indisputable, it is well to inoculate susceptible animals with the culture. The animals most suitable for this purpose are the mouse, the rat, and the guinea pig. The mouse especially takes the plague with the greatest ease, and dies in thirty-six to forty-eight hours. When the inoculated animal succumbs, very characteristic lesions are found on the body, sanguinolent congestion around the point of inoculation, buboes and ganglionic congestion of the neighboring regions, congested spleen, black and friable. The plague bacilli are in great quantities in all the organs, especially in the glands, the spleen, and the liver.

Detection of Urobilin in Urine.—The ordinary test with an alcoholic solution of zinc salt may be simplified in the following manner: 100 cc. of urine are acidified with 8 or 10 drops of HCl. and shaken with 20 cc. of chloroform. After separating, 2 cc. of the chloroform layer are tested with 4 cc. of a solution of 1 gram of crystallized zinc acetate in a litre of 95 per cent. alcohol. At the junction of the two layers the green fluorescent ring characteristic of urobilin will appear, and on shaking, a fluorescence which is rose colored by reflected light will be distinguished throughout the liquid. Certain commercial alcohol gave the reaction, probably due to the accidental presence of a zinc salt.

Secretary Kelsey sends the following report of the last meeting held. We would glad to have similar reports from other societies. We ought to have more active microscopical organizations.

The New Jersey State Microscopical Society held its November meeting in Geological Hall, Rutgers College, and a large attendance of members listened to the reports from the various sections.

Under the section of "Agriculture," Prof. B. D. Halsted exhibited specimens showing attempts at the cross-breeding of corn, the idea being to produce a pink variety from cross-breeding of black and white varieties. His experiments had

been only partially successful. He also exhibited photographs of the same, and specimens of the young plants in flower pots. In the growing plants were several stalks which were perfectly white.

In this same section the president, F. B. Kilmer, called attention to the fact that the supply of drug plants was growing scarce and that attention was now being turned to farmers to cultivate drugs. This is now being carried on in Europe, and efforts are being made to introduce cultivation in the United States.

Under the section of "Bacteriology," Dr. A. L. Smith exhibited under the microscope a streptococcus which is sometimes associated with erysipelas.

Under the section of "Botany," J. A. Kelsey exhibited under the microscope minute crystals of oxalate of lime, which were found in ivy berries, which were very painful when handled.

Under "Geology," Dr. Albert Chester exhibited a microscope recently acquired by the geological department of the college, which embraced the latest improvements and advantages in this class of instruments. Under the microscope he exhibited a specimen of Labradorite, showing a beautiful iridescence.

From the section of "Histology," Dr. H. R. Baldwin exhibited under the microscope a specimen of muscular fibre, and explained the functions of the fibres in animal economy.

In the section of "Mineralogy," J. A. Manley made an elaborate exhibition of specimens illustrating the occurrence of iron pyrites in the clay beds near Sayreville. These specimens illustrated the several forms of crystallization, among them being a specimen of fossil wood with pyrites; several beautiful specimens of small pyrite crystals 1-400 of an inch in size, each one being a perfect cube. He also showed a spear pyrite from a locality where this was originally discovered, and also a specimen from a new locality recently discovered by him on the north side of the Raritan. He stated that these localities are the only ones in the United States from which this rare mineral is obtained. He also showed a set of specimens illustrating how the curious rattle-stones from the locality of Sayreville are formed.

Dr. Chester stated that under the geological survey Mr. Manley and Mr. Valient had discovered eight minerals in New Jersey which had never before been found within the state.

Under the section of "Physics," Dr. VanDyck explained the action of moisture upon glass, particularly lenses, and exhibited the head of a cockroach under the microscope.

The meeting was well attended and much interest manifested.

At the annual meeting of the American Society of Naturalists at Johns Hopkins University, the following officers for the ensuing year were elected: President, Wm. T. Sedgwick; vice-presidents, L. O. Howard, L. M. Underwood, J. Walter Fewkes; secretary, A. D. Mead; treasurer, M. M. Metcalf; executive committee from society at large, G. H. Parker, J. McK. Cattell. Among other important transactions, the society appropriated fifty dollars toward the support of the University table at Naples Zoölogical Station, and fifty dollars to support a table at the Marine Biological Laboratory at Woods Holl.

The Council of the American Association for the Advancement of Science held its regular annual meeting at Johns Hopkins University, Baltimore. Prof. C. S. Minot was elected president. Two hundred and forty-seven new members were elected, which makes the total membership of the association over two thousand.

Publications Received for Journal Library.

Observations Concerning the Significance of Streptococci in Comparative Pathology. Veranus A. Moore, M. D.

The Photo-Micrographic Room and Apparatus in the Anatomical Laboratory of the Johns Hopkins University. A. G. Hoen, M. D.

The Slime Moulds. Thos. H. MacBride.

A Taxonomic Study of North American Ranunculaceæ. K. C. Davis.

The Mineral Resources of New Caledonia. Frederick D. Powers, M. Inst. M. M.

Root Tubercles and Nitrogen Appropriation.

Live Covers for Country Homes. Byron D. Halsted. Bull. No. 144, New Jersey Agri. Expt. Sta.

Xenia, or The Immediate Effect of Pollen in Maize. Herbert J. Webber. Bull. No. 22, U. S. Dept. of Agri.

Fruit Diseases and How to Treat Them. L. C. Corbett. Bull. No. 66, West Virginia Agri. Expt. Sta.

Bulletins 8, 9, 10, High School Department, and Bulletin 14, College Department, University of New York.

Two Diseases of Red Cedar, caused by Polyporus juniperus n. sp. and Polyporus carneus Nees. Herman von Schrenk.

Progress of Commercial Growing of Plants Under Glass. B. T. Galloway.

Progress in the Treatment of Plant Diseases in the United States. B. T. Galloway.

Bulletino del Laboratorio ed Orto Botanico. Dott Fl. Tassi.

Fungi Novi Australiani. Fl. Tassi.

Proceedings of the Pathological Society of Philadelphia, Vol. III, No. 10.

Thirteenth Annual Report, Maryland Agri. Expt. Sta., Vol. No. 13.

Index Catalogue of the Library of the Surgeon-General's Office, U. S. Navy. Second series, Vol. V.

Annual Report of the Smithsonian Institution, U. S. National Museum, 1898.

Bulletin of the University of Kansas. Kansas University Quarterly, Vol. IX, No. 2.

Catalogue of Periodical Literature in the Lloyd Library. Cincinnati, Ohio, 1900.

Naturæ Novitates. Bibliographie neuer Erscheinungen aller Lander auf dem Gebiete der Naturgeschichte und der exacten Wissenschaften. Jahrgang XXI, 1899.

Archiv für Mikroskopische Anatomie und Entwicklungsgeschichte. O. Hertwig und W. Waldeyer in Berlin.

A Description of the New Wing of the Laboratory of Hygiene at the University of Pennsylvania. A. C. Abbott, M. D.

The Opening Services of the Institute of Hygiene of the University of Pennsylvania.

Abstract of Proceedings of Linnean Society of New South Wales. September 26, 1900.

Monthly List of Publications. U. S. Dept. of Agri. October, 1900.

Present Conditions of the Eastern Oyster Experiment, and the Native Oyster Industry. Report of State Biologist, F. L. Washburn, University of Oregon, 1900.

A Contribution to Our Knowledge of the Food Fishes of the Oregon Coasts, from specimens collected by B. J. Bretherton. Report of State Biologist, F. L. Washburn, University of Oregon, 1900.

Publications of U. S. Department of Agriculture. No. 174, sixth edition.

Statistics of Oleomargarine, Oleo Oil and Filled Cheese. R. A. Pearson, M. S., Bureau of Animal Industry, U. S. Dept. of Agri.

Bulletin of the New York State Museum, Vol. 8, Nos. 37 and 39.

Journal of Applied Microscopy.

VOLUME III. DECEMBER, 1900. NUMBER 12

MICRO-CHEMICAL ANALYSIS.

IX.

POTASSIUM.

The following have been proposed for the detection of potassium. The choice of the method to be employed will, of course, depend upon the nature of the material to be tested. In all ordinary work Method *I* will undoubtedly be chosen on account of its simplicity, neatness, rapidity, and from the fact that it is less subject to errors than most of the other tests.

I. Chlorplatinic Acid (Platinum Chloride). *
II. Bismuth Sulphate.
III. Sodium Bismuth Thiosulphate.
IV. Phosphomolybdic Acid.
V. Picric Acid.
VI. Stannic Chloride.
VII. Cerium Sulphate.
VIII. Sodium Cobalt Nitrite.
IX. Sodium Tartrate.
X. Perchloric Acid.
XI. Ammonium Fluosilicate.
XII. Conversion into sulphates, double sulphates (alums), etc.

I. Chlorplatinic acid added to solutions containing salts of Potassium, gives rise to the separation of Potassium Chlorplatinate.

$$K_2SO_4 + H_2Pt\,Cl_6 = K_2Pt\,Cl_6 + H_2SO_4.$$

Method.—Place, on a glass slide, a drop of a moderately dilute solution of the material to be tested; near by, place a drop of the reagent; cause the two drops to unite, but do not mix them together. In a few moments, relatively large and beautifully formed, strongly refractive, bright, but deep yellow, crystals

* It is more logical, and more in accordance with our modern chemical theories, to consider that when platinum is dissolved in the usual manner in "aqua regia," we have chlorplatinic acid formed in solution, and not platinum tetrachloride. It follows, therefore, that the addition of a solution of this reagent to solutions of potassium compounds, gives potassium chlorplatinate, K_2PtCl_6, and not a double chloride of potassium and platinum, as expressed by the formula $2KCl \cdot PtCl_4$.

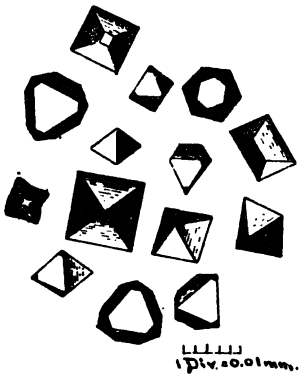

Fig. 29.

appear. The usual form is that of the regular octahedron (see Fig. 29), sometimes showing faces of the cube. Horizontally elongated octahedra, or octahedra shortened parallel to one of the pairs of faces, are not unusual. Rhombicdodecahedra are less often obtained.

Since the crystals usually lie on one of the faces of the octahedron, there is apt to result an abnormal development of this face, and the diagonally opposite and parallel face. The resulting crystal will exhibit an hexagonal outline when seen through the microscope, i. e., viewed from above. Combinations of cube and octahedron may lead to a somewhat similar appearance.

Not infrequently preparations are obtained in which twinning is very marked, and others in which there is a grouping of crystals in threes or fours. Of the twin crystals, one form seems to predominate; it results from the union, in reversed position, of two halves of an octahedron where the dividing plane is parallel to the two opposite faces.

Remarks.—The size and development of the crystals formed will depend largely upon the concentration of the test drop. In very concentrated solutions, minute crystalline grains or the skeletons of octahedra (see Rubidium) are produced. In very dilute solutions the crystals appear only after some time. In case the test drop proves to be of the latter sort, heat it gently to cause slight evaporation, or add a little alcohol.

Thin crystals are lemon yellow in color, but those which attain a considerable thickness are of a decided orange tint.

The best results are obtained from neutral or very slightly acid solutions. Excess of mineral acids is to be avoided, sulphuric acid in particular. Either evaporate and remove them, or mitigate their action by adding sodium acetate or sodium carbonate. If the latter salt is used, care should be taken to avoid making an alkaline solution.

Ammonium, rubidium, cesium, and thallium also give octahedral crystals with chlorplatinic acid, the composition of the salts being similar to that of the potassium salt. The solubility of these compounds, and consequently the size of the crystals produced, decreases rapidly in the order in which the elements are named. Ammonium will give octahedra of the same size as those of potassium, hence its absence must be assured before the test can be considered conclusive of the presence of potassium.

The crystals furnished by rubidium are far smaller than those of potassium or ammonium, while cesium and thallium can seldom be made to yield more than crystalline grains, unless the solution is exceedingly dilute. If, therefore, moderately dilute solutions are employed, and the reagent added in the manner suggested above, it is almost impossible to confuse potassium or ammonium with the other elements just mentioned.

If salts of ammonium are present, or suspected of being present, place a little

of the material to be tested on platinum foil, moisten with water, dry, and ignite carefully, until all the ammonium salts have been driven off. Dissolve the residue in water, with the addition of a little hydrochloric acid if necessary; transfer to a glass slide, and test.

If it is desired to test for sodium or glucinum in the same drop, add more of the reagent, then a drop or two of alcohol (care being taken to keep the slide tipped during the addition of the alcohol). Allow the preparation to evaporate, and examine with polarized light. The salts of potassium, rubidium, and cesium (and thallium) are isometric, hence will remain dark while those of sodium and glucinum polarize quite strongly. (See Sodium and Glucinum.)

The reagent should never be employed, even though freshly prepared, without first testing it by evaporation to ascertain whether octahedral crystals are deposited, since potassium may have been extracted from the containing vessel, or ammonium absorbed from the air. In making the reagent from metallic platinum it must be borne in mind that the acids employed may contain salts of potassium or ammonium, or both.

Exercises for Practice.

See suggestions given under Rubidium and Cesium.

II.—Potassium sulphate added to a solution of Bismuth sulphate gives rise to the formation of a difficult soluble double Sulphate of Potassium and Bismuth.

$$3K_2SO_4 + Bi_2(SO_4)_3 = [3K_2SO_4 \cdot Bi_2(SO_4)_3].$$

Method—The reagent, as also the material to be tested, is prepared in the manner suggested under Sodium (Method *V*), and in like manner the more or less pasty mass is added to the reagent drop and the preparation warmed. (The formation of crystals takes place also in the cold.) There will appear, if potassium is present, circular disks, rapidly growing into neat, well formed, hexagonal plates, the latter in turn often rapidly change into more or less regular, six-pointed stars and rosettes. The test is to be considered a satisfactory one only when the hexagonal (or coffin-like) plates are obtained (Fig. 30).

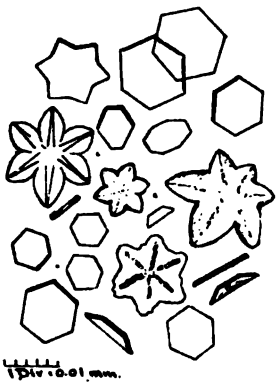

Fig. 30.

Remarks.—It is essential that the reagent drop be not concentrated, otherwise the characteristic hexagons of the potassium salt will not be obtained, but merely a mass of irregular circular disks.

Ammonium, rubidium, and cesium form compounds in every way similar to that of potassium. The first two cannot be distinguished from potassium by this test, but the cesium double salt almost invariably exhibits a few peculiarities which usually permit its being recognized, for it is more highly refractive, the hexagonal plates are more clearly cut, and grow to a greater thickness; moreover, the edges of many of these crystals are modified or beveled. This latter form of crystal does not appear to be formed by potassium, rubidium, or ammonium.

It follows, from the above facts, that the bismuth sulphate test for potassium is conclusive only in the absence of ammonium and rubidium, and perhaps also cesium, for it is doubtful whether the peculiar cesium crystals will always be formed.

As stated under Sodium, it is rarely that lithium can be made to yield any crystals.

Exercises for Practice.

Try, as directed under Sodium, a simple salt of this element.

Repeat, using in turn salts of K, NH_4, Rb, Cs.

Make a mixture of K and Na; test, and note that both elements can be detected simultaneously.

Attempt to detect Na in a mixture of Na and Ca salts. Repeat the test, using a mixture of Na, K, and Ca.

Test a mixture of K and Cs.

III.—An alcoholic solution of Sodium Bismuth Thiosulphate added to solutions of potassium salts precipitates a double Thiosulphate of Potassium and Bismuth.

$$6KCl + 3Na_2S_2O_3 + Bi_2(S_2O_3)_3 = [3K_2S_2O_3 \cdot Bi_2(S_2O_3)_3 \cdot 2H_2O] + 6NaCl.$$

Method.—The reagent is prepared as follows: place in a small watch-glass (25mm.) a small drop of dilute hydrochloric acid; add repeatedly minute amounts of basic bismuth nitrate, warming gently from time to time and stirring thoroughly, until a trace of the basic nitrate remains undissolved; now add a bare trace of hydrochloric acid, just sufficient to dissolve the little residue of bismuth salt, no more; then add to the preparation a tiny drop of water. A permanent precipitate of bismuthyl chloride should result. If the first drop of water does not produce a permanent precipitate, another drop must be added. To this latter turbid solution a saturated solution of sodium thiosulphate is carefully added, with constant stirring, a tiny drop at a time, as long as any of the precipitate remains undissolved. An excess of sodium thiosulphate is to be avoided. A perfectly clear, faintly yellowish solution should result. To this clear liquid add alcohol (95 per cent.) drop-wise, until a permanent turbidity results, which is in turn cleared up by the addition of a single drop of water.

Fig. 31.

The solution of the material to be tested is evaporated at the corner of a slide so as to leave a thin, uniform, dry film. A drop of the alcoholic solution of the reagent, prepared as above, is placed next the film of substance, and is drawn across the latter. In the presence of potassium, fine lemon yellow mono-

clinic* needles are produced. By transmitted light these acicular crystals have a greenish tint (Fig. 31).

Remarks.—It is essential that the reagent be freshly prepared, since the compound formed is very unstable. In a short time after making, sulphur and bismuth sulphide and sulphate separate.

If too much hydrochloric acid has been used to dissolve the bismuth salt, a milky solution results (due to the separation of sulphur) which soon becomes dark and muddy. Only clear solutions should be employed.

If the amount of potassium present is high, and the solution of the reagent strongly alcoholic and quite concentrated, an almost amorphous precipitate results when the reagent is drawn across the substance.

Since potassium bismuth thiosulphate is quite soluble in water and insoluble in alcohol, varying strengths in the alcoholic solution will produce crystals of varying size and form. Weak alcoholic solutions will give slowly formed prismatic crystals. In such a case the delicacy of the reaction is greatly diminished.

Rubidium and cesium give practically identical reactions, save that there is a greater tendency toward the formation of larger and more prismatic crystals than in the case of potassium.

Thallous salts gave a very insoluble precipitate in tiny grains.

Ammonium salts yield no crystals whatever, hence this method offers an excellent means of distinguishing between NH_4 and K, but when present, ammonium interferes with the test for potassium.

Salts of lithium, the magnesium group, manganese, iron, etc., yield no precipitates, but in the presence of these elements the delicacy of the test for potassium is much diminished.

Calcium seems to give no crystalline compound capable of separating, but strontium and barium often furnish skeleton crystals which are white (colorless) and so cannot be confused with the yellow needles of the potassium salt.

Elements precipitated by hydrogen sulphide in acid solution not only interfere because of the fact of their being precipitated as sulphides in the test drop, but because many of them form crystalline compounds with the reagent. None of these compounds, however, seem to be such as would lead to error.

Although it does not apparently make any material difference with what acid the potassium is combined, the best results are to be obtained from chlorides or nitrates.

Exercises for Practice.

Try, in turn, the reagent on potassium chloride, nitrate, and sulphate.

Then test salts of ammonium, rubidium, cesium, lithium.

Test a mixture of ammonium and potassium.

Test a mixture of potassium and calcium; then one of potassium and barium.

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* Huysse, Zeit. Anal. Chem., 1900, 39, 9.

IV. Phosphomolybdic acid added to solutions containing potassium precipitates Potassium Phosphomolybdate.

$$3KNO_3 + [H_3PO_4 \cdot 10MoO_3 \cdot x\,H_2O] = [K_3PO_4 \cdot 10MoO_3 \cdot 3H_2O] + 3HNO_3.*$$

Method.—Beside a drop of a very dilute solution of the substance to be examined, acidulated with nitric acid, place a drop of a dilute solution of the reagent in rather strong nitric acid. Cause the reagent to flow into the drop of the solution being tested. Almost instantly, there is formed a light yellow cloud of exceedingly minute crystals. Near the circumference of the test drop, where slower formation has taken place, the crystals are somewhat larger. When the reaction is thus performed, lemon-yellow spherical and disk-like crystals of potassium phosphomolybdate are obtained. Very rarely will more perfect forms be seen (Fig. 32). Should the conditions be exceptionally favorable, tiny, ill-formed octahedra can be distinguished.

Fig. 32.

Remarks.—Both the reagent and the solution of the substance must be very dilute, otherwise the potassium salt formed will be precipitated as infinitely minute grains, and the reagent itself will separate in large, well-formed octahedra. The latter cannot well be mistaken for the potassium salt, however, since the crystals are too large and too well formed. These octahedra of phosphomolybdic acid are only formed when the acid is fully hydrated. In strong nitric acid a compound separates, with less water of crystallization, in the form of rhombic prisms. Hence, it is advisable to have the reagent drop consist of a solution of the solid acid in fairly strong nitric acid, although this does not wholly prevent the separation of some fully hydrated phosphomolybdic acid.

Warming the drops before uniting them, does not seem to yield any better crystallization of the potassium salt.

Ammonium, rubidium, and cesium give like reactions, the salts formed having a similar composition to that of the potassium compound, but being more insoluble. Of this same group, sodium and lithium give no reaction, nor do any of the other commonly met with elements.†

V. The addition of Picric acid to solutions of salts of Potassium leads to the formation of Potassium Picrate.

$$KCl + C_6H_2(NO_2)_3OH = C_6H_2(NO_2)_3OK + HCl.$$

Method.—Evaporate a drop of a solution of the substance in such a way as to obtain a thin, uniform film. Across this film draw an alcoholic solution of picric acid (trinitro-phenol).

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*The formulas of the various salts of phosphomolybdic acid are still a matter of uncertainty. The general opinion is that the salts vary in composition according to conditions under which they are formed. Neither is the composition of the free acid itself thoroughly understood. The formulas given above are probably the simplest form in which these compounds can be expressed. It is more than probable that, actually, they are more complicated than represented.

† Bismuth is an exception to this rule; its phosphate being insoluble in nitric acid. So, too, silver, under unusual conditions, will yield a crystallizable phosphomolybdate.

Potassium picrate separates immediately as long yellow or acicular prisms of the orthorhombic system. Skeleton crystals, and long, thin, tapering forms are also obtained. The latter, according to Haushofer, extinguish at an angle of 38° to the long axis of the crystal (Fig. 33).

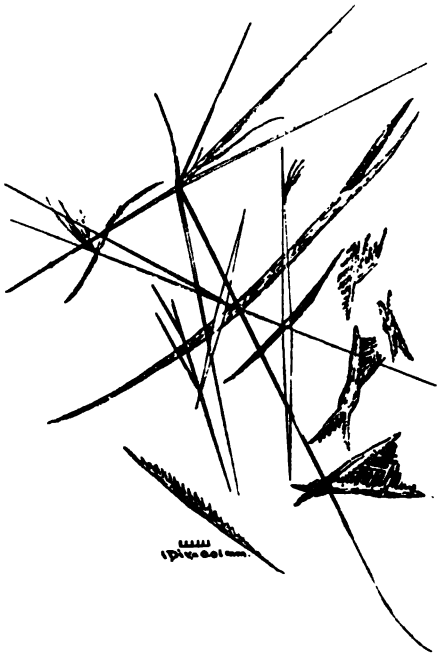


Fig. 33.

Remarks. — Trinitrophenol itself crystallizes in orthorhombic prisms, but not in the long, slender acicular crystals given by the potassium salt, hence there is little danger of confusing the two.

The alcoholic solution of the reagent should have just sufficient water added to prevent the drops, when applied to a slide, from flowing over the glass. Enough of the reagent should be in solution to give a very decided yellow color.

Since the potassium salt is quite soluble in water, and rather insoluble in alcohol, the addition of too much water to the reagent will prevent the precipitation of potassium.

Rubidium and cesium give salts which closely resemble that of potassium. Ammonium sometimes gives potassium-like needles, more often very long and thin plates, with a greater tendency to grouping together. The ammonium salt is probably monoclinic.

Thallium yields crystals like potassium, but smaller and more insoluble.

The sodium and lithium salts are much more soluble than those of the other members of the group, hence they do not immediately separate.

Picric acid gives crystalline compounds with a large number of the elements, therefore its usefulness as a reagent is greatly restricted. It is, however, true, that in few of these salts is the form of the crystals such as to lead to confusing them with potassium picrate.

Exercises for Practice.

Try reaction on salts of K, Rb, Cs, Na, NH_4.

Try also on salts of Mg, Cd, Ca, Ba, Ag, Pb.

E. M. Chamot.

Cornell University, Chemical Laboratory.

Bacteriological Instruction in Medical Schools.

One of the important problems that has arisen to puzzle the management of medical schools in recent years is the proper regulation of the instruction in Bacteriology.

It is a subject apart from medicine proper, and though of the utmost importance in every department, finds itself indissolubly associated with no particular major subject. The result of this is that except in the few schools that are able to support a separate chair of Bacteriology, the subject becomes incorporated with others and is sometimes a division of Pathology, sometimes a branch of Hygiene, occasionally a department of chemistry, and not rarely a subject taught by the professor of Surgery.

It of necessity follows that, being thus taught from a variety of standpoints, there is great lack of homogeneity among different institutions in consequence.

Granting that a knowledge of bacteriology is essential to successful medical education, we must first ask ourselves what purpose this knowledge will perform for the student, and afterwards consider how the knowledge is best attained.

Knowing the life history of bacteria, it is possible to comprehend the phenomena of infection, to grasp the origin of many pathological processes, to understand the nature of certain histological lesions, to appreciate the means adapted to protect the public health against epidemic diseases, to have a clear conception of such chemical processes as fermentation and putrefaction, to conceive the utility of antitoxins in certain diseases, and to realize the meaning of a multitude of conditions arising on every hand. See in how many spheres it will be necessary for the student to draw upon his knowledge of the micro-organisms to explain or elucidate important yet commonplace things!

The students received into medical schools are as varied in their education and intelligence as the colors of the rainbow. Some have plodded through years of classic training not knowing what was to be their future calling; some have had first-class scientific training in schools preparatory to medicine; some come from high schools and small country colleges with a smattering of everything, and unfortunately some are almost without information upon any subject. The preliminary examination and the requirements of state law are every day excluding the unprepared and making the men more homogeneous, but the question of the preliminary education remains unsolved and the classical men will come to the medical school without an idea of bacteria or bacteriological manipulations, while the science men will come, many of them already expert in the technic. Is it wise to give these men the same instruction? Shall the bacteriology of the medical school be something different from that taught elsewhere, or shall it attempt to cover the whole subject?

The object of a medical school is to educate in medicine. It is a training school for doctors. The better educated its men are *in medicine*, the better is the school. A medical school is not a general science school, and in exactly the same way as its courses in chemistry are arranged to open the way to a proper understanding of the physiology of digestion, metabolism, secretion, and excre-

tion, and its courses in anatomy to lay the foundation of surgery and physical diagnosis, so bacteriology should appear in its strictly medical relations and strive to make clear the cause, the symptoms, and the termination of those affections which come within its scope.

In these days of many specialties and still more specialists, it is often made to appear that the medical school is a place where all the specialties are taught. Indeed, it is a very pregnant question just how much a plain doctor ought to know. Where does the general practitioner end, and the specialist begin?

Must every man graduating from school be qualified to do all that his specialist teachers have taught? How does this apply in bacteriology? Are we to make bacteriologists of these men who want to be doctors? Must we carry them through the systematic study of the non-pathogenic micro-organisms, worry them about chromogenesis, nitrification, enzymes, etc., teach them water examinations and sewage disposals, arouse their curiosity about hog-cholera, chicken-cholera, mouse-septicemia, and the long list of diseases of the lower animals, or shall we restrict their attention to the purely medical side of the subject, and touch briefly upon enough of the rest to prevent the ill effects of too narrow a horizon?

It seems to me that the latter course is the proper one, and that in the medical school the medical student must engage himself in *medical* subjects only. Before he begins medicine it is well if he has had general bacteriology; after finishing his course he can engage in any special or advanced work for which he is qualified and in which he becomes interested, but during the course in medicine, *medical bacteriology* only.

The question now arises, when shall the instruction be given? In some institutions the bacteriology is taught in the first year, in others in the second, in still others in the third year. In some schools the course is purely elective. If the medical bacteriology is to prepare the way for the student to comprehend the source and cause of disease, it should by all means precede the courses upon those subjects and be placed in the first year. If, on the other hand, it is to be led up to by the teaching in pathology, it must come later. We should not forget, however, that if the student has no knowledge of bacteria and their habits, much that he sees at the medical and surgical clinics and nearly all that he sees in the pathological demonstrations must remain either arbitrary or unintelligible to him. For this reason I have removed bacteriology from the third to the first year of my course. I do not think the subject should be elective, as it is of too vital importance. Advanced courses and special courses should be offered to the men as electives, but there should be a regular instruction that everyone must take.

There has been a growing tendency that has borne good fruit, but is becoming so forced at present that its usefulness is likely to be overdone and lead to sterility. I mean the laboratory and the practical work. From a time when teaching was all didactic, we are hurrying to a time when the teaching will all be practical.

In bacteriology a well-equipped laboratory is an absolutely indispensable feature, but is it all that is required? Is there not still a vast field of possibility in the lecture room? Not the old-fashioned, stupid, never varying didactic lecture,

formal and cold, but a lecture modern in its style, up-to-date in its details, well illustrated by specimens, charts, and diagrams, and full of snap. Cannot such topics as immunity, infection, antitoxines, disinfection, the relation of bacteria to the lesions they produce be better explained in the lecture room than in a laboratory? It has always seemed to me that the laboratory is only an adjunct to our teaching paraphernalia and has its place just as charts, projectoscopes, specimens, models, etc.

I have now arranged my course in bacteriology to extend over three years. In the FIRST YEAR the work is purely didactic, and the men are interested in all matters pertaining to the biology, vital manifestations and pathogenic relations of bacteria and have pointed out to them *why* sterilization, aseptics and antiseptics are used in the surgical clinic, and *why* disinfection is practiced after infectious diseases, and *how* bacteria produce disease. In the SECOND YEAR in the laboratory they perform the essential manipulations, see the bacteria for themselves, and study them in their relations to the lesions about which they are coincidentally learning in the course upon general pathology. In the THIRD YEAR I meet them on alternate weeks for the discussion of such special subjects as infection, immunity, preventive inoculation, antitoxins, and the study of the important organisms not treated of in the laboratory course.

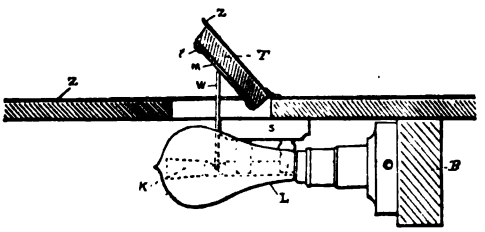
So important do I deem it that the medical relations of the subject be brought out, that I always begin as soon as the men have acquired the simplest technic, to give them pathogenic forms, first those like the colon and typhoid bacilli, cholera, etc., that are unlikely to cause laboratory infection, and so working up to tuberculosis, diphtheria, anthrax, and the more infectious forms.

JOSEPH MCFARLAND, M. D.
Professor of Pathology and Bacteriology in the Medico-Chirurgical College, Philadelphia.

A Convenient Source of Artificial Light for the Laboratory Table.

One of the difficulties the writer has had to deal with has been the lack of an easily adjusted light that could be readily placed in position, yet would not be in the way of the source of daylight. The problem was solved in the following way:

My microscope table is a flat-top desk, .75 x 1.10 M. This is covered with zinc (Z) which resists ordinary influences, viz., stains, an occasional drop of acid, oils, balsam, etc., and is resilient enough not to cause breakage of fragile laboratory ware apt to be dropped on it, as glass surfaces will do.



About 25 cm. from the middle of the anterior border I cut a small trap door (T) 75 cm. wide and 90 cm. long, and hinged at the back. A piece of mirror glass (M) is tacked on the under surface of this, by clipping off its corners and fastening it with drawing

board tacks (t) on the then projecting corners of the trapdoor. A ground glass incandescent bulb (L) is then fastened to a block (B) as shown in the diagram, in such position that the greatest brilliancy of the bulb is reflected in the mirror when raised to about 55 degrees. (In the drawing it is a little too far back.)

A knife switch (S) is secured at the left edge of the opening of the trap door in about the relation shown on the diagram. A piece of stout steel wire (W) is bent at right angles so that the long arm measures 75 mm. and the short arm about 18 mm. A hole having been bored into the right side of the handle of the "knife" (K), the short arm of the steel wire is driven and soldered into this in such a manner as to cause the switch to raise the trap when the light is "cut" on. The stringing of the wires will suggest itself; the wires emerge between porcelain cleats at the back of the table and are there connected with a flexible cord attached to a plug which may screw into a socket on the window sill or other convenient place. When it is desired to move the table, the plug can be unscrewed from the socket. I also use a "green back" reflector under the light, which, for the sake of clearness, is omitted from the diagram.

I have used this about six months and am highly pleased with it. It never fails to excite the admiration of visitors.

The same arrangement without the trap door can be used on a glass top table by inverting a dissecting block over the light when in use (like the B. & L. "T").

Wm. Krauss.

Randolph Bldg., Memphis, Tenn.

The Camera Lucida in Blood Counting.

The enumeration of blood cells is tedious, and requires, throughout, an exact technique. For most practical purposes, it may be supplanted by the volumetric estimation of cells by the hæmatokrit, but the latter instrument is not sufficiently delicate to distinguish fluctuations in the white cells, and, if it be necessary to enumerate the latter, it is better to count the reds also, although a rough comparison may be made between the white cells as determined by count, and the reds as determined by volume. The greatest difficulty in enumerating cells is the indistinctness of the lines ruled on the base of the blood chamber, when the chamber is filled with a liquid having somewhere near the same refractive index as glass. When the chamber is filled with air, the lines become quite easily visible. After considerable thought and experiment, I have developed the following method of blood counting, which differs from the usual way only in the diminished eye-strain. Indeed, I may say that for some eyes, blood counting by the old method becomes absolutely impossible, the lines being invisible.

Using the same objective and eye-piece that are to be used for the examination of blood, and applying the Abbe camera lucida, the lines of the dry hæmacytometer are drawn on a piece of cardboard. After preparing the blood for examination in the usual way, the lines are reflected back on to the microscopic field, and are used in counting, the faint lines of the stage micrometer—for such the chamber of the hæmacytometer really is—being disregarded. Although,

with this camera and good lenses, there is comparatively slight spheric aberration, the cardboard must always be in the same relative position to the microscopic field, that is, to the microscope stand. If one edge of the cardboard is placed along one side of the standard, pencil marks will enable this position to be regained at any examination. It simplifies the labor of reproducing the network of the micrometer merely to make X marks at the intersections of the lines, and to fill in the chart by heavy ruled lines. The aberration for each square is so slight that it may be disregarded. In order to make the lines as plain as possible, with the minimum of illumination of the chart, I have used a green background with the lines in red, thus taking advantage of the law of complementary colors.

As in all uses of the camera lucida in microscopy, an equable division of light is necessary. In the Abbe camera, little slips of dark glass are provided to fit into a niche over the eye-piece, so as to obscure the microscopic image to the right degree. However, it is more often necessary to shade the cardboard, by inserting the shaded slip laterally, so as to interfere as little as possible with the appearance of the stained blood cells. In using the simplest form of camera, all regulation of the division of light must be made by shading the external field, and by manipulating the condenser and reflector of the microscope. A large book in front of the chart of ruled lines is a convenient shade. The best results are obtained from diffused daylight.

Only a few squares need be drawn by the camera, say nine to sixteen. When these have been counted, the field of blood can be shifted, preferably by the mechanical stage. The computation is precisely as in the old method.

In certain cases, it becomes desirable to know the number of leucocytes. Quantitative estimation of leucocytes by the hæmatokrit is quite impossible, unless they are enormously increased. A leucocytosis of ten to fifteen times the normal is still too small to measure in the capillary tube, though occasionally one encounters a medical article in which comparatively small leucocytoses are reported as estimated in this way.

In the enumeration of white cells, it is now customary to use the same diluting pipette as for reds, and to calculate the area of the entire microscopic field. Aside from the slight arithmetic inconvenience of using π (3.14159) as a factor, it is difficult to measure the field accurately.

The ruled portion of the hæmatocytometer is altogether too small for use in counting white cells with ordinary dilutions of blood. By the camera lucida, squares of two- or three-twentieths of a millimeter may readily be traced, and the leucocytes are readily counted, using a low power.

It is practically impossible to distinguish the different forms of leucocytes within the counting chamber, for two reasons, the impossibilty of employing differential stains and of focussing a high-power objective through the thick cover-glass and tenth-millimeter layer of blood. Thus, the enumeration of the different forms of leucocytes must be compared with that of the red cells, having first obtained the ratio of whites to reds. This may be done by using a "net-micrometer," but I must confess never to have seen such an instrument, having been quite unable to obtain it in this country. By means of the camera lucida, any field of a stained-blood mount may be divided into squares, as

small as necessary. Parts of the specimen will be too thickly strewn with red cells to enable a comparative count, but in most parts of a carefully prepared mount it is possible to count the cells in small squares.

In all blood study, much eye-strain is saved if the leucocytes are quite deeply stained, although Cabot prefers a very light stain. Personally, I believe that the exact coloring of the cells is a matter of indifference, provided that the differentiation is well marked. A good rough test is to see if eosinophiles present bright red granules. Otherwise, the successful employment of the camera lucida depends entirely on skill in regulating the illumination.

A further advantage of the camera lucida is the ease with which magnification is measured.

A. L. Benedict, M. D.

Dental Department, University of Buffalo.

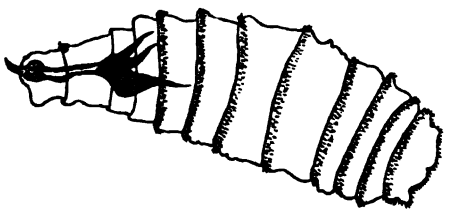
A Parasite, the Supposed Cause of Epilepsy in a Boy.

The object in presenting this brief sketch and camera drawing of this parasite is to call the attention of those who may have a chance to investigate cases of epilepsy to see if there is such a cause responsible for the disease in general, and also for a name for the parasite if it is known.

The history of the case as reported to the Southern Illinois Medical Association at its last semi-annual meeting, is as follows: A boy, now ten years old, has for the last four years been subject to epileptic fits, or spasms. There is a general constipation, which is the most pronounced when the spasms are the worst, but upon a free catharthesis being produced, he is relieved. The spasms at their worst are sometimes as many as twenty in twenty-four hours. The fecal excreta at such a time is found to be "literally alive" with these entozoa. Some of these were sent to a scientist in St. Louis, and he pronounced them unknown to him. The president of the association, Dr. A. M. Lee of Carbondale, brought me some of the material in formalin for investigation, but like the St. Louis man, I have to say that I do not recognize them.

That these parasites are the cause of the epileptic spasms in this case seems undoubted, for the following reasons: As soon as the colon is relieved of them the spasms cease. That the spasms are reflex seems to be further confirmed by the fact that there is also globus hystericus present, which is recognized as reflex from the pelvic organs.

Now, as to the worm, for worm it seems to be. The adult forms are one-twelfth of an inch long, and of the shape shown in the figure. They are translucent. The anterior end is the smaller and bears two black hooks, only one of which is shown in the figure. Below these hooks, which are slightly divergent, is a black marking that is internal, and may be an abbreviated enteric canal. It is present in all



specimens examined and branches in all as is shown in this, the largest branch extending into segment 5. The worm is distinctly marked in its ectoderm into twelve segments, but no corresponding marks are shown in the endoderm. The incisures, with the exception of the first three, have a band of short spines that project backward, and the posterior segment is somewhat villous at the end. There is also a patch of the spines on the neck under the points of the hooks.

As to where in classification this interesting parasite belongs, I have very little to say. In shape and the bristles at the incisures of the joints, it resembles some of the fly larvæ of the family Oestridæ, especially some species of the genus Dermatobia; but it is too small for any of these, and there could be only one brood of Dermatobia without new eggs introduced into the system. In this case there is a recurrence of the spasms in from three to six weeks after copious catharthesis produces relief, showing that they must reproduce themselves. The hooks at the anterior end and the neck spines point to its being a Nemathelminthous worm, as do also the external segmentation without corresponding internal mesenteries.

I hope to have more material later that will enable me to section the parasites and study their internal structure. G. H. FRENCH.

Biological Laboratory, Southern Ill. Normal University.

The Best Material for Blocks Upon Which to Mount Tissues Embedded in Celloidin.

The ideal block upon which to mount celloidin preparations preparatory to sectioning should be firm and free from resiliency; should be permanent when under alcohol at the laboratory temperature, and should contain no objectionable substance that is soluble in strong or dilute alcohol. Its specific gravity should exceed that of alcohol, it should admit of a firm and stable attachment to the celloidin, and of ready reattachment after intentional or accidental detachment. Moreover, it should be possible to easily fashion or to alter the blocks to any desired size or shape; the consistence should be such that the edge of the knife shall not be injured upon contact, and the blocks should be available and inexpensive.

Continued use has impressed me the more with the disadvantages of many of the blocks in common use. The dirty looking alcohol, saturated with resinous matters, the discolored and loosened celloidin, and the progressive deterioration of tissues is a sufficiently familiar picture when blocks of wood, either hard or soft, are employed. It is not improbable that the reputation of "short life" given tissues infiltrated in celloidin may be chiefly due to the prevalent use of wooden or cork blocks.

Appreciating this, certain workers preserve their infiltrated tissues separate from the block, and prefer the half-hour's delay necessary to cement the preparation to the block each time before sectioning, rather than run the risk of having the specimen deteriorate. Under these conditions tissues stain well, after having

been kept five or more years. Blocks of glass, porcelain, vulcanite, or vulcanite fibre have many advantages, but are not always available, are rather expensive, and in the hands of the unskilled may place the knife in jeopardy. Their shape is not easily altered and not infrequently the size necessary for a rather large or long bit of tissue is not at hand, or if found is too large for the clamp of the microtome. These various disadvantages led me, somewhat less than a year ago, to experiment with paraffin, and while I have mounted but a few hundred blocks, they have proved so generally satisfactory, that I believe they merit a more general use.

The paraffin employed should have a sufficiently high melting point as to remain firm during the warmest summer days. It should be melted and formed into cakes, having a thickness equal to the height of the desired blocks, by pouring into suitable paper, pasteboard, or metal trays. For this purpose the flat tin boxes, open at one end, that enclose the imported cakes of celloidin, answer well. These may be filled with the melted paraffin and stood in ice water. When cool the box is grasped with tongs, inverted, and a Bunsen flame played over its surface until the cake of wax slides out. Before it again cools and becomes brittle, it is convenient to cut the cake into blocks of a desirable size. The important step before using the block is to so prepare the upper surface that when the celliodin is applied, it will become so firmly dovetailed into the paraffin that it will not readily become detached. This is readily accomplished by scoring the surface of the paraffin with a knife. The knife should enter the paraffin obliquely for a distance of 4 or 5 mm. The incisions should be parallel to each other, and with but a slight intervening interval. Finally, a number of similar incisions crossing the first at right angles should be made.

By this means the upper surface of the block is covered by a large number of slanting teeth under which the celloidin will readily flow, resulting in a firm mechanical attachment. To facilitate the scoring of the paraffin the block should first be softened either by gently warming or by touching the proper surface of the paraffin to the naked blue flame.

Tissues infiltrated in thick celloidin are mounted in the usual way. If desired, a box may be formed by folding a narrow strip of thin sheet wax (or paper) about the block. The preparation is hardened and preserved in 80 per cent. alcohol. If the surface of the paraffin has been properly scored and if the celloidin is of proper consistence the specimens rarely loosen or become detached. When detached the impressions of the paraffin "teeth" are left in the hardened celloidin and facilitate a speedy reattachment to a paraffin block. The irregular under surface of the celloidin is first blotted and the surface of a block of paraffin held near a flame until the wax melts. A little of the melted paraffin is allowed to drip upon the detached surface of the celloidin, the softened face of the block pressed into place and the preparation immediately thrown into 80 per cent. alcohol. As soon as the paraffin is hard the block is ready for sectioning, the entire procedure requiring but two or three minutes.

W. Wayne Babcock.

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Journal of Applied Microscopy.

L. B. ELLIOTT, EDITOR.

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WITH this number we close the third year, and third volume, of our publication. There has never been a time during its existence when the JOURNAL has had the support and coöperation of men of science everywhere more heartily than at present. It is proper that we extend to them the assurance that the work thus contributed is appreciated by our large circle of readers, and by ourselves.

The satisfaction of completing this year's work is somewhat marred to us, however, by the knowledge that through the delay which has occurred in publishing several numbers, some inconvenience has been caused our subscribers. Such arrangements have now been completed, that no further delays will occur, and beginning with the April number the JOURNAL will be mailed promptly on the first of each month. With the first issue of the new century, the scope of the JOURNAL will be broadened so as to include all the various methods, processes, and equipments which appertain to biological and other work in which the microscope is used. While continuing to give all the information which we now give regarding the microscope, we will thus be able to give, in addition, much that will be equally useful to the laboratory worker, the physician, the industrial user of the microscope, and the individual. The increased use of the camera in scientific work, the growth of the projection lantern and photomicrographic apparatus in favor as means of demonstration, the development of field methods in the collection and preservation of material, the progress made in the preparation of natural objects for useful application in the museum, should be recorded with their allied topics, involving the use of the microscope.

There being at present no journal specially devoted to these subjects, we invite contributions from those who have practically worked out a method or an apparatus. Such contributions will thus reach a large audience, and be of service in many ways, where otherwise the work of development would be of only limited application.

* * *

The extent to which the JOURNAL can be improved will depend entirely upon the support it can obtain through subscriptions, as it stands on its own merits. Our friends will, therefore, oblige us by renewing promptly, and bringing the JOURNAL to the attention of such of their friends as may be interested.

* * *

The index will be mailed with the January number.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to Charles J. Chamberlain, University of Chicago, Chicago, Ill.

REVIEWS.

Goebel, K. Organography of Plants, especially of the Archegoniatæ and Spermaphyta. Part I. General Organography. 8vo, pp. xvi + 270, 130 figs. Clarendon Press, Oxford, 1900.

This translation of Prof. Goebel's work brings within the reach of English students the only book of recent date upon the subject of organography. The headlines of the table of contents will give some idea of the scope of the work. They are as follows:

I. *General differentiation of the plant body.* (1) Introduction. Morphology and organography. (2) Differentation of organs in the Spermaphyta. (3) Formation of organs and division of labor in the Thallophyta. (4) Normal formation of organs at the vegetative point and regeneration. (5) Concrescence and arrest.

II. *Relationships of symmetry.* (1) Introduction. (2) Position of organs on radial axes. (3) Dorsi-ventral shoots. (4) Relationships of symmetry of leaves. (5) Relationships of symmetry of flowers and inflorescences.

III. *Differences in the formation of organs at different developmental stages. Juvenile forms.* (1) Introduction. (2) Illustrative examples. (3) Reversion to the juvenile form. (4) Conclusion of the development.

IV. *Malformations and their significance in organography.* (1) Inherited malformations. (2) Malformations caused by external conditions. (3) Significance of malformations in the theory of formation of organs.

V. *The influence of correlation and external formation stimuli upon the configuration of plants.*

The average botanist will find this book a difficult one to read, because so much theoretical and philosophical matter is introduced at the outset; a careful study, however, will repay the effort, for the work is largely the result of investigations carried on in Prof. Goebel's own laboratory, and so has the freshness which one does not meet in a mere compilation. Many of the statements will not be approved by all, and are likely to stimulate research. C. J. C.

Burns, G. P. Beiträge zur Kenntniss der Stylidiaceen. Flora. 87: 313-354, pls. 13-14 and 45 text figs., 1900.

The Stylidiaceæ (Candolleaceæ of Engler and Prantl) is a small family almost confined to Australia, New Zealand, and farther India. This paper presents the results of a morphological study of the group, the various tissues being treated in some detail. Before the fertilization period the embryo-sac presents no unusual features, but immediately after fertilization the micropylar end of the sac grows out into an enormous haustorium, much larger than the entire original sac. After the formation of the haustorium the endosperm nucleus divides, and the sac is soon filled with tissue.

The first division of the egg is delayed until this stage is reached. Shortly after fertilization, the antipodals disintegrate and an haustorium is formed at this end of the sac also. Finally, the protoplasmic contents of both haustoria become transformed into a network of cellulose threads which, in case of the upper haustorium, form a plug effectually closing the micropyle. The sac is surrounded by a jacket or "tapetum," which is even more conspicuous than in the Compositæ. C. J. C.

Sargant, Ethel. Recent Work on the Results of Fertilization in Angiosperms. Annals of Botany, 14: 689-712, 1900.

The work of the past two years suggests to the writer four questions: (1) Is the phenomenon of double fertilization general among Angiosperms, or to be considered peculiar to a few species? (2) Does the twisted shape of both generative nuclei in *Lilium* indicate that they have an independent power of motion within the embyro-sac; if so, can they be considered as much reduced spermatozoids? (3) What light is thrown by these researches upon the homologies of the structures contained in the typical embryo-sac of Angiosperms? (4) Can the fusion of the second generative nucleus with the definitive nucleus of the embryo-sac be considered as a true act of fertilization?

(1) Double fertilization (at the time when the paper was written) had been reported in twenty species, representing twelve genera and five orders, three of which are Dicotyls. Land's paper on double fertilization, adding two genera of Dicotyls to the list, evidently appeared too late for notice. Miss Sargant believes that the results justify the working hypothesis that double fertilization is general in Angiosperms.

(2) In regard to the possibility of independent movement on the part of the male generative cells, it is found that in many cases these cells do not have the vermiform shape, and while the vermiform nuclei may possibly make their way through the protoplasm of the embryo-sac, the passage in same cases, as actually observed by Strasburger, is effected by the streaming movements of the protoplasm which carries the nuclei with it. Miss Sargant does not think that the term, spermatozoid, should be applied to these structures.

(3) The fusion of one of the generative nuclei with the endosperm nucleus raises again the question whether the endosperm should be regarded as an embryo, but from a morphological point of view we must account historically for the endosperm, and must find the origin of the triple fusion. The writer approves Strasburger's suggestion that the term, endosperm, be confined to the Angiosperms, and what we have called by that name in gymnosperms be termed a prothallus.

(4) Whether the fusion of the second generative nucleus with the endosperm nucleus should be regarded as a true fertilization will depend largely upon one's definition of fertilization: if one understands fertilization to be merely the fusion of two sex nuclei, the process is fertilization, for the upper polar nucleus is a sister to the egg nucleus, but the intrusion of the lower polar nucleus must find an adequate explanation. Zoölogists have shown that the union of more than two nuclei in eggs of the sea urchin commonly produces monstrous forms. Those

who regard the endosperm as a modified embryo may find this suggestion profitable.

Forty-five papers are listed in the bibliography, sixteen of which, dealing with double fertilization, have appeared since 1899. C. J. C.

Kohl, F. G. Dimorphismus der Plasmaverbindungen. Ber. d. deutsch. bot. Gesell. 18: 364-372, pl. 12, 1900.

It has been considered somewhat difficult to demonstrate satisfactorily the protoplasmic continuity between cells and, except in cases like the evident continuity through sieve tubes, it has been customary to resort to reagents, which cause a swelling of the protoplasmic strands. The present writer found that in *Phytelephas macrocarpa*, *Strychnos nux vomica* and *Coleococcus carolinensis* the protoplasmic threads are beautifully differentiated by a rather prolonged staining in a very weak solution of methyl-violet without any previous fixing, thin free hand sections being brought immediately into the staining solution. Weak safranin and brilliant blue also gave good results without fixing. The writer's figures indicate that the preparations were excellent. C. J. C.

CYTOLOGY, EMBRYOLOGY, AND MICROSCOPICAL METHODS.

AGNES M. CLAYPOLE.

Separates of papers and books on animal biology should be sent for review to Agnes M. Claypole, Sage College, Ithaca, N. Y.

CURRENT LITERATURE.

Beard, J. The Morphological Continuity of the Germ Cells in Raja batis. Anat. Anz. 18: 465-485, 1900.

The work was carried out on extensive material, embracing all the chief epochs of development, from blastoderms, without any embryonic foundation, up to and including embryos of 70 mm.; that is, up to the completely formed young skate.

A general survey of the subject is given. Eigenmann has concluded that in *Cymatogaster* (*Micrometrus*) *aggregatus* the germ-cells probably represent cells of the fifth division of the egg. They were found in an embryonic foundation in which the mesoblastic somites were not yet present.

At the close of segmentation in Raja, the germ-cells are 0.02 mm., .036 mm., and probably also 0.05 mm. in size, the last and larger corresponding to the megaspheres or large cells of Rückert, and already show a multinucleated condition. Normal germ-cells of this period contain much yolk, and the nuclei are of the duplicated character discovered by Rückert in *Cyclops* and *Torpedo*, and by Häcker in *Cyclops*. The germ-cells are thus formed in *Raja* before the embryo arises, and have to get into it from the outside—from the yolk-sac. It has been difficult to trace the first appearance of germ cells in the embryo, the most reliable character being that of size, the germ-cells being about 0.02 mm. in diameter, and the first somatic cells not exceeding 0.0125 mm.

At the close of segmentation many of the future germ-cells lie in the segmentation cavity just beneath the site of the future embryo, and doubtless subsequently wander into it. Their wanderings begin very early; with *Raja batis* embryos of only twelve mesoblastic somites there are germ-cells on their way into the embryonic foundation, between the layers of the blastoderm. In the growing zone of the developing embryo there are no cells large enough to be the progenitors of the germ-cells. In *Raja batis* the primary germ-cells persist until the embryo is at least 42 mm. long, and secondary germ-cells are found in embryos of 54 mm. onward.

The usual size of primary cells is 0.02 mm.; they are found to retain the yolk for a very long period, indicating their lack of tendency to mitosis; yolk plates are found at first and later in these cells, usually of fairly equal size; they disappear by the time the embryo has the characters of a young skate, and in one of 56 mm. are entirely gone. The protoplasm of the early germ-cells is very peculiar, colorless, and glassy, possessing no affinity for ordinary stains; osmic acid gives it a slightly brownish hue. These cells are rarely rounded, more often irregular, as if showing amœboid processes.

Taking up the question of the passing of these cells into the germinal ridge, the author first speaks of the large, yolk-laden cells, called by Rückert megaspheres. Before the embryo-formation it is impossible to pick out the germ-cells with absolute certainty, merely by their size or the amount of contained yolk. The twin character of the nucleus must be the determining point, so that in a pre-embryonic period the future germ-cells can only be recognized, as those large cells possessing this character, and those already abnormal are the megaspheres showing a multinucleated condition.

Apart from normally placed germ-cells, a varying number of those megaspheres is found in every skate-embryo of 6–20 mm.; the smaller ones exactly resemble normal germ-cells. Apart from the resemblances between these large cells and normal germ-cells, there are similarities in degenerative changes. There is an unbroken transition from the ordinary germ-cell to the largest of the megaspheres, and as many of the latter agree absolutely with the ordinary germ-cell in everything except position, it is impossible to draw any line between them. In older embryos, of 20 mm. and upwards, these megaspheres are replaced by undoubted germ-cells in abnormal position. No attempt has ever been seen on the part of one such cell to take part in the formation of any embryonic organ.

These large germ-cells occur in various remarkable places, in different embryos; some have been found in the brain and spinal cord, more occur in the skin; none have ever been seen in the notocord, though they have been found in almost every other part of the body. Some appear in the segmental mesoblast, and represent the so-called segmental gonads of the gononephrotome. They may be found in any part of the trunk mesoblast, usually in early embryos between the layers; they never occur in the tail. How do these germ-cells reach such positions? As germ-cells they have to migrate into the embryo, and they may start too early, or too far forward, or in the wrong direction. In the first case they may be placed in the nervous system or skin; in the second, they

will lie in front of the future genital region; in the last case they may be placed almost anywhere.

The germ-path is a definite one, from the yolk-sac upwards between the splanchopleure and the gut in the hinder portion of the embryo. Here, in early stages, many germ-cells are encountered in various positions. This pathway leads them directly to the position of the future "germinal ridge" or nidus. The time duration of this wandering is relatively long, the migrating cells being found in embryos of from 14 mm. to 17 mm., even 20 mm.

Until the embryo is 212 mm., the primary germ-cells remain quiescent, gradually using the yolk, but retaining the size of 0.02 mm. The ultimate fate of the many vagrant germ-cells is of slight importance compared with the fact of the large percentage of abnormally placed cells in a vertebrate animal, in every individual under a certain age. Its bearing on Cohnheim's theory in pathology, and the discoveries of Wilnis in relation to dermoid cysts, is apparent. This author seeks to prove that the dermatoid cysts found in the ovary and testis of man and mammals are rudimentary embryos, or "embryomas." Usually these growths are formed, to a greater or less extent, of structures belonging to the head end of a normal embryo. Hair, sebaceous and sweat glands, membrane bones, and nerve matter, rudiments of fore-limbs and teeth, occur more or less frequently. The author is convinced that his researches on fish are a complement to the work of Wilnis, and suggests to a certainty the explanation of the abnormal features under discussion. There is no support given to parthenogenesis in mammals by these discoveries. If development occurs, tumors known as dermoids or embryomas are the only products, nothing normal ever results.

The author next attacks the old time-honored doctrine of a germinal epithelium; shows that owing to the early, pre-embryonic appearance of the germ-cells they never were a part of the embryo, but are separated from the general mass of cells before a body or "soma" exists. An extensive summary of the work done on this point by other authors is given, pointing out the apparent errors in interpretation. In nearly all cases work was done on older embryos, and the early stages, hence, were unobserved.

In conclusion, Nusbaum's view of twenty years ago is considered to be demonstrated beyond dispute. He asserted then that the germ-cells never form part of the embryo, are always distinct, and exist before there is any embryo at all. For a certain time in *Raja batis*, as in many other types, the germ-cells and the original embryonic cell are of like generation; then a parting of the ways comes, and the germ-cells remain for a period stationary in a resting phase, while the embryonic cells start on the upbuilding of the embryo. It and its cells can no more revert to that starting point than a man to his childhood. The life of the individual has been initiated.

Secondary germ-cells later arise by the multiplication of the primary cells passing from their quiescent state. A much larger number of cells thus arises, but there are no differentiations such as are found in somatic multiplication.

Germ-cells may be regarded as unicellular organisms, which pass one part of their life-history within a multicellular sterilized stock, the embryo, or metazoon, formed by one of them at a definite period in the life-circle. A. M. C.

Allis, Edw. P., Jr. The Premaxillary and Maxillary Bones, and the Maxillary and Mandibular Breathing Valves of *Polypterus lechir*. Anat. Anz. **18**: 257–289, 1900.

The author deals in detail with the bones in question, and gives the work already done on other forms nearly connected. His summary is given in part. In fishes, not considering the Cyclostomata, there are, according to generally accepted views, two rows of teeth, one or both of which may appear in the upper jaw. These rows are called the pterygo-palato-vomerine arch and the premaxillo-maxillary. In elasmobranchs the pterygo-palato-vomerine arch alone is present; a statement probably true also for chrondrosteous ganoids. In Dipnoi this arch exists alone or with a possible addition of the premaxillary part of the other arch. In Teleosti either both arches are found or the premaxillo-maxillary alone; but the maxillary part of the premaxillo-maxillary arch is more frequently introduced, the pterygo-palatine teeth frequently replacing functionally the maxillary ones. Hence these teeth play a much more important part in fishes than the maxillary, which do not appear in the line of fishes until the Teleostean-like ganoid, *Amia*, is reached, unless they are doubtfully assumed to be present in *Acipenser*, *Lepidosteus*, and *Polypterus*.

Maxillary and mandibular breathing valves are generally found in all those fishes having a premaxillary bone. In Elasmobranchii, which lack this bone, the maxillary breathing valve possibly represents a part of the nasal velum. In Acipenser it may be represented in the barbels. In Polypterus, bones related to teeth are found developed in what are apparently the homologues of both the breathing valves. The maxillary breathing valve bone, so developed, forms a second superficial, bony layer on the roof of the mouth cavity, and it, and the valve itself, seem to foretell the secondary palate of the higher vertebrates.

The internal nostrils, in acquiring their final position in the mouth cavity, must cut the maxillary breathing valve, if it persists in higher animals, into three parts, a median and two lateral ones. The retention or greater development of one or the other of these parts would give rise to considerable variation in the bony components of the palate. A. M. C.

Willem, V. Structure of Collembola. Bull. Acad. R. Belg., **12**: 760–767, 1899. (Review in Jour. Roy. Micros. Soc., June, 1900.)

A detailed investigation has been made of twenty-eight members of this little known order. Except in *Sminthurus*, the tracheal system is entirely lacking, and the head contains a pair of metameric cephalic glands, an archaic condition recalling the Myriapoda. In the Thysanura, only one pair of glands is present. In the Collembola, as in Myriapoda, a post-antennary sense organ is present, while in Thysanura it is absent. The Collembola also differ from the Thysanura in possessing no Malpighian tubules, the excretory function resting in the fat body which contains concretion of sodium urate. In regard to oögenesis, the author finds some novel results. The ova are smaller than the nutritive cells, and actually penetrate into these, so that previous investigators have mistaken follicular cells for ova, and ova for vitelline cells. The author believes the Collembola constitute a phylum distinct from the Thysanura, and of more ancient origin. He adheres to the view that the Apterygota are, as a whole, the most primitive of existing insects. A. M. C.

NORMAL AND PATHOLOGICAL HISTOLOGY.

RICHARD M. PEARCE, M. D.

University of Pa., Philadelphia, Pa., to whom all books and papers on these subjects should be sent for review.

Schmieden. Cirrhosis and Multiple Adenomata of the Liver. Virchow's Archiv., **159**: 290, 1900.

Schmieden, in connection with the report of a case of multiple adenomata of the liver with cirrhosis, reviews the literature, and discusses the relation between simple hypertrophy, adenomata, and carcinomata. In the histological study of his case he found no relation between the interlobuler bile ducts and the adenomatous new growths. He, however, demonstrates that the islands of liver cells which are isolated and surrounded by the connective tissue of cirrhosis, take on a vicarious growth, and are the points of origin of the adenomata. The cells of these areas are larger than normal areas, and are frequently multinucleated, and it is by division of these giant cells that the adenomata are formed. In some of the isolated areas of large adenomata, a transformation of the columns of cells into an alveolar arrangement was observed, and a picture of true cancerous growth produced. The writer emphasizes his view that cirrhosis always precedes the formation of adenomata, and that while the cirrhosis is a chronic process, the tumor formation is a recent and rapidly developing process. R. M. P.

Cullen, Thomas S. Associate Professor of Gynæcology in the Johns Hopkins University. Cancer of the Uterus: its Pathology, Symptomatology, Diagnosis, and Treatment. D. Appleton & Co, 693 pp., 1900.

Although this work is intended for the practicing physician, the author's aim being "to give the family physician a clear idea of the early signs of carcinoma, in order that he may always be on his guard," there is a vast amount of material of great interest to the pathologist. Symptomatology, diagnosis, and treatment are described in a thorough and convincing manner, but the masterful way in which the pathology of cancer of the uterus is presented gives to the work its chief value.

The illustrations, numbering over three hundred, are accurately and excellently executed, and are probably unequalled. They consist of diagrams, schemata, and drawings in colors, and in black and white, illustrating various operative procedures, the normal structure of the uterus, and the macroscopic and microscopic appearances of pathological changes in the uterus.

In reading the work one sees many points of interest to the student of pathological histology. The writer divides all cancerous growths of the uterus into one or the other of the following four groups:

1. Squamous cell carcinoma of the cervix.
2. Adeno-carcinoma of the cervix.
3. Adeno-carcinoma of the body.
4. Squamous cell carcinoma of the body. (Rare.)

In the examination of uterine scrapings the following two methods of rapid diagnosis are recommended:

Method I—Requiring fifteen minutes.

1. Make frozen sections, and place in 5 per cent. aq. sol. formalin for 3 to 5 minutes.
2. Fifty per cent. alcohol, 3 minutes.
3. Absolute alcohol, 1 minute.
4. Water.
5. Hæmatoxylin, 2 minutes.
6. Decolorize in acid alcohol.
7. Water.
8. Eosin.
9. Ninety-five per cent. alcohol, through absolute alcohol, to either creosote or oil of cloves, and mount in Canada balsam.

Method II—Requiring two hours.

Place tissue, measuring 1 x .5 x .2 centimeters, in 10 per cent. formalin, for two hours, make frozen sections, and stain as in Method I.

In regard to the etiology of cancer, the author states: "Summing up the various analyses as to the causation of carcinoma, we find that heredity seems to have little influence; trauma, as produced by parturition, apparently bears a causal relation to cancer of the cervix, but not to that of the body. Neither the theory of Cohnheim nor that of Ribbert explains its origin, and the weight of evidence is against the parasitic theory." R. M. P.

Schmieden. Ueber den Bau und die Genese der Leber-cavernome. Virchow's Archiv. **161**: 373, 1900.

The work is based on thirty-two cases from man and animals. The livers of the new born were especially studied.

The theories in regard to the origin of these cavernous formations are as follows:

1. Primary growth of connective tissue.
2. Vascular congestion.
3. Primary atrophy of liver cells.
4. Biliary congestion.
5. Hæmorrhage.

The most important of these theories are the first and second. The first is the oldest, and is at present strongly supported by Ribbert, who regards the liver cavernoma as an angio-fibroma. The second theory, recently supported by Scheffen, is, that in circumscribed areas the vessels become congested, and that the liver cells between disappear.

The writer introduces a sixth theory. He believes that the liver cavernoma owes its origin to a developmental error, and should be included with the other tissue malformations of Group 1 of Lubarsch's classification. Although it may be called a tumor in a broad sense, it does not belong in the same class as the cavernous angiomata of other organs, as, for example, the skin. R. M. P.

Jacobsthal, H. Zur Histologie der Arteriennaht. Beiträge zur Klinischen Chirurgie, Bd. 27, Hf. 1, 1900.

Jacobsthal gives the following summary of repair after suturing of arteries: The more or less wide wound space in the arterial wall is filled with blood and fibrin, which penetrates laterally into the

vessel wall, and spreads to the depth into the adventitia and perivascular tissue. In the lumen of the vessel there is deposited about the suture and on the surface of vessel wound only traces of clot.

An endothelial covering, which is visible in the first days after operation, covers the clot and suture, and closes them in from the lumen. Soon after this there develops an extensive connective tissue and blood vessel formation in the adventitia, and to small extent also in the media. This new tissue penetrates the clot and organizes to a certain extent. Thus there is formed a cellular end-, mes-, and per-arterial growth. Gradually there is instituted a retrograde process, in which the cells become fewer and poorer in cytoplasm, while between them fibrillar material appears. In the media and adventitia this is chiefly collagenous connective tissue with only a little elastica. In the intima an extraordinarily rich, new formation of fine elastic lamellæ and fibres develops which extends to the formation of a kind of second elastica, at least in the neighborhood of the suture. Remains of fibrin are to be found sometimes in the thickened intima just as is granular blood pigment in all the coats of the vessel. The suture lying in the lumen is completely isolated by the end-arterial growth, which is covered by endothelium. In the adventitia it is surrounded by granulation tissue, with foreign body giant cells. Resorption proceeds very slowly; apparently the threads remain as foreign bodies a long time. A new formation of muscle fibres was not observed. W. G. H.

CURRENT BACTERIOLOGICAL LITERATURE.

H. W. Conn.

Separates of papers and books on bacteriology should be sent for review to H. W. Conn, Wesleyan University, Middletown, Conn.

Sommerfeld. Ueber die Verwendung des Milchthermophisis. Ber. Klin. Woch. *37*: 916, 1900.

The use of high temperatures for destroying pathogenic germs in milk (sterilization and pasteurization) has come into general practice in Europe more than in this country. That 100° or even 70° C. results in slightly decreasing the digestibility of the milk is generally recognized. Sommerfeld makes a series of tests with a new type of apparatus called the Thermofore, which is designed to remove the bacteria from the milk without the heat. The basis of the new method is to retain the milk at a moderately high temperature—about 50° C.—for several hours. This temperature does not change the physical or chemical nature of the milk, and presumably does not decrease its digestibility. Its effect upon bacteria, however, is precisely the same as pasteurization. The number of living bacteria decreases rapidly, and after several hours falls as low as it does in pasteurized milk. Milk containing typhus or tubercle bacteria is rendered harmless. This method, the author thinks, offers a means of preventing the milk from distributing disease, without imparing its value as food, and is, therefore, a more promising method of treatment than either sterilization or pasteurization. H. W. C.

Newman. Bacteria, especially as they are related to the economy of nature, to industrial processes and to the public health. G. P. Putnam's Sons, N. Y., 1899.

This book is designed, neither for a scientific treatise nor for a text-book; but rather to give to any one interested in science an epitomized account of bacteria and their general relation to processes of nature. The contents include excellent accounts of bacteria as plants, accompanied by figures; also a discussion, in succession, of the important problems connected with bacteria in water, in air, bacteria and fermentation, bacteria in soil, in milk and its products, and other foods. The two last chapters discuss the problems of immunity and antitoxins, and the relation of bacteria to disease. The whole series of problems of the relation of bacteria to processes in nature are thus passed in rapid review. The book is carefully written, has very few mistakes, and is written in a style easily intelligible, even to those who have no special scientific training. One who wishes to gain an idea of the facts known at the present time in regard to this group of organisms, can do no better than to read carefully the pages of this book. H. W. C.

Schattenfroh und Grassberger. Ueber Buttersauregährung. Arch. f. Hyg. **37**: 54, 1900.

The authors find that the butyric fermentation of butter is commonly produced by a single species of bacterium, and that most of the other butyric organisms described by various authors have little or nothing to do with the phenomenon. The organism to which they attribute the fermentation is a bacillus which they name *Granulobacillus saccharobutyricus immobilis liquefaciens*. This species they find universally present in butter, and also widely distributed in nature, finding it in earth, water, cheese, and fæces of man and cattle. The organism produces butyric acid, together with CO_2H and right-handed lactic acid with a small quantity of alcohol. It ferments carbohydrates, but not lactic acid, and is non-pathogenic. While other species of bacteria are found, this author thinks this is the one which is, in most cases, the cause of the butyric fermentation of butter. H. W. C.

Rogoyski. Zur Kenntniss der Denitrifikation und der Zersetzungserscheinungen der tierischen Exkremente in der Akererde. Cent. f. Bac. u. Par. II, **6**: 778, 1900.

Experiments in regard to the action of micro-organisms upon fertilizers have led to the conclusion that ordinary fertilizers in the soil are subject to considerable nitrogen loss under the agency of micro-organisms. The nitrogen is lost chiefly in the form of free nitrogen and ammonia. The author of this paper raises the question as to whether the experiments on this subject really teach the conclusions drawn. All of the experiments have been made upon samples of soil containing a very large amount of nitrogenous material. The author carries on experiments with soil mixed with varying quantities of nitrogenous material, and reaches the conclusion that, whereas there is a large nitrogen loss when the soil is mixed with large quantities, such nitrogenous loss does not occur when the amount of fertilizer in the soil is small. Consequently, the problem of nitrogen loss in ordinary soils through bacteriological agency is not a fact with which agriculture has any concern, since such loss does not occur in the ordinary conditions of the soil. All of the directions based upon this sup-

posed nitrogen loss which have been given to farmers, the author, therefore, regards as needless. H. W. C.

Freudenreich. Reift der Hartkäse gleichmässig durch die ganze Masse, oder von aussen nach innen? Cent. f. Bak. u. Par. II, **6**: 685, 1900.

The problem of the cause of cheese ripening, although the subject of numerous investigations, has not yet been solved. Adametz has insisted that in hard cheeses the effect is produced by bacteria, which make their way inward from the surface. Freudenreich, on the contrary, has claimed that the ripening is produced by lactic bacteria which are present in the milk and are distributed uniformly through the cheese. In this article Freudenreich has described a careful series of observations designed to determine whether the cheese ripens from without, inwards, as insisted by Adametz, or uniformly through the mass, as would be true in accordance with his views. His method of determining the grade of ripening is based upon chemical analysis and not upon simple taste and smell, as was the case in the investigations of Adametz. He finds that the ripening occurs with absolute uniformity through the whole cheese. H. W. C.

Koning. Der Tabak, Studien über seine Kultur und Biologie. Cent. f. Bak. u. Par. II, **6**: 566 (abstract), 1900.

This long article upon the study of tobacco is of interest to bacteriologists in connection with the problem as to the relation of bacteria to the fermentation and flavor production. Loew has insisted that tobacco fermentation is not due to bacteria, but to an unorganized enzyme. The author, however, holds that it is produced by bacteria. He finds upon the tobacco leaves five species of bacteria which he regards as intimately associated with the fermentation process. Of these, three belong to the Proteus group and one to the Subtitis group. The author instituted a number of experiments in the artificial fermentation of sterilized tobacco leaves with various combinations of the bacilli isolated, and claims to have had success in developing typical and pleasant flavors to the tobacco.

Another portion of the work concerns the matter of the so-called mosaic sickness of tobacco, which the author regards as due to an organism which is so small as to escape discovery with the microscope entirely, and even to pass through the Chamberland filter.

In Cent. f. Bak. u. Par. II, **6**: 590, Prof. Loew replies to this article as well as to others, reaffirming his position that the flavors are due to enzymes and not to bacteria, and insisting that the work of Koning has not proved the agency of bacteria in the process. H. W. C.

Harrison. The Foul Brood of Bees. Cent. f. Bak. u. Par. **6**: 422, 1900.

The question of the "foul brood of bees" is one that has, for a long time, agitated those interested in bee culture. Since 1885 it has been known to be produced by a bacillus named *Bacillus alvei*. Although this bacillus was known, and its casual connection with the foul brood of bees was shown by Cheshire and Cheyne fifteen years ago, a complete knowledge of this organism has been lacking. Harrison has supplied this lack by giving a long, careful study to the organism in question and its relation to the cause and distribution of this infection. He gives a careful discussion of the

geographical distribution of the disease, and of the means by which the disease is ordinarily distributed from hive to hive. The whole paper is an exhaustive discussion of this infection, which is very troublesome in Europe, and is becoming so in this country. H. W. C.

Celli. Die neue Prophylaxis der Malaria im Latium. Cent. f. Bac. u. Par. I, **28**: 696, 1900.

Among the numerous experiments of this last summer, directed toward the prevention of malarial infection, there are none of greater interest than those carried on by Celli, among the railroad employees of Italy. These people lived in localities badly infected with malaria. Celli, believing it practically impossible to interest the public in the destruction of mosquitoes, and doubting the efficacy of a wide use of quinine as a prophylactic, desired to find a means of protecting the habitations of the ordinary employees from mosquitoes. Accordingly, he applied netting to the houses of the laborers, in some cases applying it even to the rude huts made of hay and grass, in which the poorest people dwell. These measures were not perfect, but they did give to the inhabitants of the houses a greater or less protection from mosquitoes, and at the same time enabled them practically to live in the open air.

None of them were prevented from engaging in their ordinary labors. The result was surprisingly successful. During the two years of the experiment, among the 207 employees subject to the experiment only ten suffered from malaria, in spite of the fact that they were living in the most unhealthful portions of the country, and in spite of the fact, too, that nearly all of their neighbors succumbed to the disease. The disease was thus proved to be, not epidemic, and not to be carried from person to person, provided the individuals were protected from mosquito bites. The author, therefore, concludes that the simple adoption of mosquito netting for the windows and doors of the laborers' houses will result in very great reduction to the amount of malaria with which the people suffer in these infested districts of Italy. H. W. C.

Nakanishi. Bacillus variabilis lymphæ vaccinalis, etc. Cent. f. Bak. u. Par. I, **27**: 641, 1900.

Nakanishi makes a contribution to the vexed question of the active agents in vaccine virus and probably, therefore, in small-pox. He finds present in the epithelial cells of the vaccine pulp of calves a rod-shaped bacillus with bipolar staining properties. This he succeeds in cultivating in agar cultures made with calves' lymph, finding that the organism grows readily and resembles the diphtheria bacillus. Experimental inoculations upon animals were partly negative and partly positive. When inoculated into the arms of children he claims there were produced typical vaccine vissicles. His conclusion is that this bacillus is the active agent in vaccine virus, and probably also in small-pox itself. H. W. C.

Rambousek. Vergleichende und kritische Studien, betreffend die Diagnostik des Bact. typhi und des Bact. coli. Arch. f. Hygiene, **38**: 382.

The author contributes a series of experiments upon the vexed but important question of the differences between the typhoid and the colon bacilli. His general conclusion is, that in regard to most characteristics which have been used for separating the two, such as resistance to acids, production of acids, production of cindol, reduction of nitrates,

and reduction of pigments, the distinction between the two bacteria is only a quantitative one, and that all of these characters are possessed by the Bact. coli in a higher degree than by the Bact. typhi. The essential distinction is that Bact. coli can produce gas in a sugar holding medium, while the Bact. typhi produces no gas. H. W. C.

NOTES ON RECENT MINERALOGICAL LITERATURE.

ALFRED J. MOSES AND LEA MCI. LUQUER.

Books and reprints for review should be sent to Alfred J. Moses, Columbia University, New York, N. Y.

Penfield, S. L., and Warren, C. H. Some New Minerals from the Zinc Mines at Franklin, N. J.; and Note Concerning the Chemical Composition of Ganomalite. Am. Jour. Sci., iv. 8: 339, 1899.

The new species are found in a limited area and with unusual associated minerals, indicating prevalence of peculiar conditions during formation.

Hancockite.—Occurs massive or cellular massive, brownish-red to maroon in color, and in very minute (0.5 mm. long) yellowish-brown, lath-shaped crystals, resembling epidote in habit; lustre, vitreous; pleochroic; H.=6.5–7; G.=4.03. Fuses to a black, slightly magnetic globule; reacts for Pb and Mn; insoluble in HCl before fusion; yields little water at high temperature.

Analysis:

SiO_2	Al_2O_3	Fe_2O_3	Mn_2O_3	PbO	MnO	MgO	CaO	SrO	H_2O
30.99	17.89	12.33	1.38	18.53	2.12	0.52	11.50	3.89	1.62=100.77.

Yielding formula: $H_2R_4''\ R_6'''\ Si_6O_{26}$, which is that of epidote, but the mineral differs from any variety of epidote by having Pb and Sr isomorphous with Ca, these two elements being rare in combination with silicic acid. Named after E. P. Hancock of Burlington, N. J.

Glaucochroite.—Occurs in small (2 mm. greatest diam.), orthorhombic, prismatic crystals, and in columnar aggregates, imbedded in white matrix (nasonite). Sometimes penetration and contact twins observed, with prism axes crossing at about 60° and 120°. Crystals generally a combination of two prisms, 110 and 120, the faces being bright but vicinal, and showing no terminal planes. Fracture, concoidal; lustre, vitreous; color delicate bluish-green, with pink areas seen on a few specimens; H.=6; G.=3.407; $a:b:c$=0.440:1:0.566 (approx.).

Analysis:

SiO_2	MnO	CaO	PbO	FeO
31.48	38.00	29.95	1.74	trac=100.17.

Yielding formula: Ca Mn SiO_4. The mineral hence comes next to monticellite in the chrysolite group. Fuses to brownish-black globule, and does not color flame. Soluble in HCl, yielding gelatinous silica. Gives strong reaction for Mn. Found in very small amount, associated with brown, garnet, and yellow ascinite. Named on account of its color, from γλαυκός=blue-green and χροια =color.

Nasonite.—Occurs massive crystalline, white in color, with greasy to adamantine lustre and mottled appearance, due to inclusions of garnet and ascinite. Forms the common matrix for glaucochroite. System probably tetragonal. H.=4; G.=5.425.

Analysis:

SiO_2	PbO	ZnO	MnO	FeO	CaO	Cl	H_2O
18.47	65.68	0.82	0.83	0.10	11.20	2.81	0.26=100.17
							O equiv. of Cl=.63
							99.54

Yielding formula: $Pb_4(PbCl)'_2\ Ca_4(Si_2O_7)_3$. Decrepitates, but fuses easily to semi-transparent globule, and gives Pb flame. On charcoal, with R. F., gives Pb coat. Soluble in dilute HNO_3, yielding gelatinous silica. Named after F. L. Nason, formerly of the N. J. Geol. Survey.

Ganomalite.—Author thinks that the mineral will be found to contain enough H_2O to yield formula $Pb_4(PbOH)_2Ca_2(Si_2O_7)_3$. In this case the formulæ of ganomalite and nasonite are closely analogous, as are also their physical characters, and the two minerals furnish a good example of the isomorphous relation between chlorine and hydroxyl in complex molecules. Name of *mesosilicates* suggested for minerals of this class.

Leucophœnicite has crystalline structure (prob. monoclinic), vitreous lustre, and light purplish-red or raspberry color. H.=5.5—6; G.=3.848.

Analysis:

SiO_2	MnO	ZnO	FeO	MgO	CaO	Na_2O	K_2O	H_2O
26.36	60.63	3.87	tr.	0.21	5.67	0.39	0.24	2.64=100.01

Yielding formula: $R_5(R.OH)_2'(SiO_4)_3$, in which R=metals (chiefly Mn), proving it to be a manganese humite, but with no Fl. isomorphous with hydroxyl. Fuses easily to brownish-black globule. Yields little H_2O in closed tube, and reacts for Mn. Soluble in H Cl, yielding gelatinous silica. Found associated with gem-like willemite and brown vesuvianite. Discovery of this mineral may lead to the finding of a series of Mn minerals similar to the Mg minerals of the humite group. Named on account of its color, from λευκός=pale or light, and φοινι=purple-red.

L. McI. L.

Penfield, S. L. Graftonite; a New Mineral from Grafton, N. H., and its Intergrowth with Triphylite. Am. Jour. Sci., iv., 9: 20, 1900.

Crystals and fragments present a rough weathered appearance, and consist of thin, alternating layers of dark (triphylite) and light (graftonite) material, the lamination being parallel to *b* (010) of the graftonite. Color, a delicate salmon; lustre, vitreous to resinous; H.=5; G.=3.672.

Analysis:

P_2O_5	FeO	MnO	MgO	CaO	Li_2O	H_2O
41.20	30.65	17.62	0.40	9.23	0.33	0.75=100.8

Yielding formula: $R_3P_2O_8$, R standing for the bivalent metals Fe, Mn, and Ca. Monoclinic, with forms observed: *a*, (100); *b*, (010); *m*, (110); *l*, (120); *n*, (130); *d*, (011); *e*, (021); *p*, (111). Darkens and fuses easily to a slightly

magnetic globule. After fusion in forceps, flame shows bluish-green color of P. Reacts for Mn. Readily soluble in HCl. Occurs irregularly disseminated through a coarse, crystalline mass of quartz and feldspar, associated with beryl, black tourmaline, garnet, and mica.

The mineral is interesting, as being one of the very few anhydrous, normal phosphates observed; and also on account of the curious intergrowth with triphylite. In this intergrowth the graftonite (forming $\frac{2}{3}$ to $\frac{3}{4}$ of the total) exerts a controlling influence upon the external crystalline form (triphylite is orthorhombic). The minerals have not intergrown with pinacoid faces in common, as shown by the different extinction angles in the lamellæ; but probably a dome face (102) of the triphylite is in contact with the clinopinacoid *b* (010) of the graftonite. It also seems "probable that the crystals must have developed in a solution or medium, which contained the chemical constituents for the formation or both compounds, and that the *growth* was of such a nature that graftonite was deposited at one period and triphylite at another." L. McI. L.

NEWS AND NOTES.

American Women at the Laboratories of Naples and Woods Holl—That women are taking an active part in the field of scientific research is evidenced by the enthusiastic efforts of the Association for Maintaining American Women's Tables at the Zoölogical Stations at Naples and Woods Holl, and for Promoting Scientific Research by Women.

The Association announces the offer of a prize of one thousand dollars for the best thesis presented by a woman on a scientific subject, embodying the results of her independent laboratory research in any part of the field covered by biological, chemical, and physical science.

The thesis presented will be judged by a regularly appointed Board of Examiners representing the departments above named. Theses offered in competition are to be presented to the executive committee of the association, and must be in the hands of its secretary before December 31, 1902. The prize will be awarded in April, 1903.

The members of the Board of Examiners for Biological Science are: Dr. William H. Howell, Johns Hopkins Medical School; Dr. William Trelease, Washington University; Dr. Charles O. Whitman, University of Chicago; Dr. Edmund B. Wilson, Columbia University.

Naples.—The Zoölogical Station at Naples was opened by Professor Anton Dohrn in 1872 for the collection of biological material and for the study of all forms of plant and animal life. Under the personal direction of Professor Dohrn and his assistants, the station has developed into an international institution of great importance for scientific research and for the professional training of professors and students of all countries. The annual support of a table for research costs five hundred dollars, and entitles the government or association supporting it to appoint to the table qualified students, who are furnished by the Station with all materials, apparatus, and assistance free of cost. It often happens that

one table is used by four or five biologists in the course of a year. The United States at present owns but three tables, that of the Smithsonian Institute, the University Table, and the American Women's Table.

This Association is maintained by annual subscriptions of fifty dollars each. In the year 1900 the following colleges, associations, and individuals were contributors: Association of Collegiate Alumnæ, Women's College in Brown University, Bryn Mawr College, Massachusetts Institute of Technology, Mount Holyoke College, University of Pennsylvania, Radcliffe, Smith, Vassar, and Wellesley Colleges, Woman's Education Association of Boston, Woman's College of Baltimore; and Miss Mary E. Garrett, Mrs. Phœbe A. Hearst, Mrs. Seth Low, Miss Lillian V. Sampson, Mrs. Fanny Bullock Workman.

Woods Holl.—For the summer of 1901 the Association also offers under the sanction of the director, the free use of an Investigator's Table at the Marine Biological Laboratory at Woods Holl, Massachusetts, to any applicant who is eligible for the Naples Table, and who may desire the benefit of preliminary work at Woods Holl before making application for the Naples Station.

Each appointee of the Association, who, by virtue of her scholarship and previous training, is, in the judgment of the Executive Board, entitled to such distinctive title, will be known as a Scholar of the Association for Maintaining the American Women's Table at the Zoölogical Station at Naples. The appointments are made by the Executive Board with the coöperation of a regularly appointed Board of Advisors, on whose judgment the Executive Committee relies for decision in questions relating to the scholarship of candidates based on the results of work presented for examination. The members of the present board of advisers are Professor Ethan A. Andrews, of Johns Hopkins University, Professor R. H. Chittenden, of Yale University, and Dr. W. T. Porter, of the Harvard Medical School.

Appointments are made for a longer or shorter period of time, as may seem in each case expedient, but no appointee is designated as a Scholar of the Association whose term of study at the Station has been less than three months. Women will be appointed in preference, but if no well qualified women present themselves, men will be eligible in their stead.

Full information with regard to the advantages for research and collection of material offered at Naples, may be obtained from former "Scholars" of the Table, whose addresses will be given on application to the secretary.

The year of the Association begins in April, and all applications for the year 1901, both for the Table at Naples and for that at Woods Holl, should be sent to the secretary on or before *March first, 1901.*

Application blanks for the use of candidates, and any information relating to the Tables will be furnished on application to the secretary, Florence M. Cushing, 8 Walnut street, Boston, Mass.

S. R. C.

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INDEX.

Abnormalities in development of chick, 976.
Academy of Science of St. Louis, 733.
Achlya Americana, a new variety, 693.
Actinomyces, staining, 1051.
Action of micro-organisms upon fertilizers, 1102.
Action of proteolytic ferments on milk with special reference to galactase, the cheese ripening enzyme, 811.
Action of salt solution upon eggs, 945.
Action of water upon glass, 893.
Acute lobar pneumonia, histology of, 977.
Advanced elementary science, 839.
Agnolite, 912.
Albugo candida, fertilization of, 938.
Alcohol vapor as a disinfectant, 1069.
Allantois of chick, 1003.
Alloys, micro-structure of, 910.
American Microscopical Society, 23rd annual meeting, 932.
American Society of Naturalists, 18th annual meeting, 657.
American women at the laboratories of Naples and Woods Holl, 1107.
Amnion, histology of, 956.
Amnion and allantois of chick, 1003.
Amyloid tumors in upper air passages, 977.
An epitome of human histology, 842.
Anærobic cultivation in fluid media, 1006.
Analcite, 848.
  Optical anomalies of, 914.
Ancylite, 1041.
Ancylus rivularis Say, 979.
Angiosperms, histology of, 740.
Antipodal cells in the embryo-sac of grasses, 718.
Apospory in Anthyrium felix fæmina, 688.

Apparatus:
  Filter for micro-chemical analysis, 678.
  For collection of bacterial material at Charing Cross Hospital, Eng., 824.
  For drawing objects natural size, 891.
  For instantaneous photo-micrography, 797.
  For keeping constant temperature, 884.
  For measuring blood in the widal test, 962.
  For measuring crystals, 771.
  For micro-chemical work, 793.
  For obtaining plate cultures or surface growths of obligative anærobes, 811.
  For photomicrography in the anatomical laboratory of Johns Hopkins University, 866.
  For staining with heat, 693.
  Photomicrographic, 684.

Application of the Widal-Gruber reaction with dried blood, 885.
Aquaria, fresh water, 995.
Araceæ, studies on, 937.
Areas of large cells in the lymph nodules of the spleen in diphtheria and other infections, 940.
Arnold steam sterilizers, regulation of water supply in, 715.
Arrangement of serial sections, 1058.
Arsenopyrite, constitution of, 710.
Artificial production of normal larvæ from the unfertilized eggs of the sea urchin, 1034.
Ascaris megalocephala, toto mounts, 1012.
Atacamite, 882.
Bacillus variabilis lymphæ vaccinalis in vaccine virus, 1104.
Bacteria, biology of, 1009.
  In leguminous plants, 1007.
  In milk at time of milking, 1007.
  In stomach of cat, II, 675; III, 724; IV, 782; V, 827.
  Rapidity of locomotion, 1041.
  Relation to economy of nature, industry, and public health, 1102.
  Structure and development, 1040.
Bacteriological department of Charing Cross Hospital, England, 824.
Bacteriological instruction in medical schools, 1084.
Bacteriological literature, reviews, 701, 810, 1005, 1039, 1068, 1101.
Bacteriology, practical questions in, 931.
  Systematic, 1008.
Bad lands of Nebraska and South Dakota, photography in, 748.
Barytes, quartz rocks from Salem, Madras, 710.
Bastnäsite, 914.
Bdellostoma storeti, development of, 1004.
Best material for blocks upon which to mount tissues embedded in celloidin, 1090.
Bibliographies, 717.
Biological laboratory of Western Reserve University, 949.
Biology in secondary schools, 859.
Blast lamp, portable, 986.
Blind vertebrates in North America, 767.
Blood dilutions in the Widal reaction, 961.
Blood plates of the human blood, 761.
Blue prints, 835.
Bone, lacunæ and canaliculi of, 843.
  Some experiments on, 696.
Botanical literature, reviews, 687, 758, 801, 839, 871, 902, 937, 972, 998, 1030, 1063, 1093.
Brain material for macroscopical study, 880.
Brass' formula, 1015.
Britholite, 1041.
Bubonic plague, bacteriological diagnosis of, 1073.
Burettes, to remark, 915.
Butyric fermentation of butter, 1102.

Calycanthaceæ, determination of relationships in, 939.
Camera, vertical, 935.
For micro-photography, 1025.
Lucida in blood counting, 1087.
Canada balsam for ringing slides, 1060.
Cancer, experimental production of, 700.
Cancer of the uterus, 1099.
Carotid gland of Mammalia and its relation to the suprarenal capsule, 1032.
Case for micro-chemical apparatus, 823.
Caterpillars, transportation of, 914.
Cedarite, 1072.
Cell division in sporangia and asci, 902.
Inclusions in carcinomata, 700.
Life, physics of, 1003.
Protoplasm, structure of, 697.
Celloidin sectioning, irrigating apparatus for, 994.
Cement for Berkefeld filters, 959.
For Liquid mounts, 712.
Chalcolamprite, 1042.
Changes in the blood vessels of Syphilis, 814.
Cheese ripening, cause, 1103.
Chick embryos, 1010.
Chromite, occurrence, origin and chemical composition of, 710.
Cirrhosis and multiple adenomata of the liver, 1099.
Cladophoras of Europe, 873.
Clasmatocytes, 906.
Cleaning Desmids, 1026.
Clepsine, 1010.
Clinographic projection, simplified method of obtaining, 945.
Collection of butterflies, 900.
Collembola, structure of, 1098.
Comparative study of the so-called polychromatophilous degeneration of red corpuscles, 765.
Compound oösphere of Albugo bliti, 801.
Condensers and objectives in practicable photomicrography, 753.
Conochilus and Vorticella as commensals, 989.
Convenient source of artificial light for the laboratory table, 1086.
Cordylite, 1041.
Cox-Golgi staining method for staining nerve cells, 674.
Crystal angles, determination of, 965.
System, definition of, 943.
Crystalline structure of nuggets of gold and platinum and of ingots of gold, 942.
Crystallography, 881.
Crystals, behavior of, with polarized light, 966.
Measurements of, 770.
Plasticity of, 1071.
Cytology, embryology and microscopical methods, reviews, 693, 761, 805, 840, 874, 906, 974, 1003, 1032, 1065, 1095.
Dairy bacteria, classification of, 1008.
Daphnia, experiments upon, 1019.
Pulex, 980.
Delafield's hæmatoxylin, staining prothallia with, 669.
Desmids, cleaning, 1026.
Development of ciliated cells, 805.
Embryo in angiosperms, 745.
Embryo-sac in Peperomia pellucida Kunth, 871.
Vessels of vascular bundle, 803.
Villi of the human intestine, 840.
Devices for exhibition of objects in the teaching museum, 1053.
Diabetes mellitus, a case of, quickly following mumps, 909.
Diamond, reproduction of, 913.
Diatom shells, flexibility of, 991.
Diatoms, photomicrographs of, 712.
Die wichtigsten vegetabilischen Nahrungs und Genussmittel, 760.
Differential stain for cell structures, 799.
Dip net, 915.
Diphtheria, large cells in the lymph nodules of the spleen in, 940.
Diphtheria bacillus, changed appearance of, 704.
Dipterous larvæ, experiments upon, 1019.
Distomum hepaticum, embryos of, 993.
Double fertilization in Compositæ, 1031.
Double staining of spores and bacilli, 1005.
Duplex substage, 933.
Earthworms for sectioning, preparing, 680.
Effect of different influences on normal temperature of cattle, and relation of same to tuberculin test, 703.
Effect of digesting bacteria on cheese solids of milk, 703.
Effect of digestive acids on bacteria, 724.
Effect of ions upon myogenic and neurogenic rhythmical contractions, and upon embryonic and muscular tissue, 874.
Effect of ions upon the aggregation of flagellated infusoria, 763.
Embedding ova and embryos in paraffin, 883.
Embryo in angiosperms, development of, 745.
Embryo-sac, development of, in monocotyledons, 1064.
Embryo-sac in certain gamopetals, 802.
Embryo-sac in Peperomia pellucida, 804.
Embryology of Corylus, 872.
Enantiomorphism, 913.
Endeiolite, 1042.
Epidermis of Tubifex rivulorum Lam., nervous structure of, 706.
Epistolite, 1041.
Equipment of laboratories for secondary schools, 665.
Equisetineæ, histology of, 672.
Erlicki's solution, 1015.
Erythrocytes of Amphiuma and Necturus, 761.
Evolution of plants, 688.
Experimental methods in study of development of frog, 884.
Experiments with culture media upon microorganisms, 1021.
Eyes of blind vertebrates of North America, 767.
Eyes of lower animals, 704.
Federoffite, 1072.
Feldspar, determination of, 881.
Fergusonite, 882.
Fertilization, mechanism of, 1012.
Fertilization in angiosperms, 1094.
Fertilization in conifers, 1065.
Fertilization in some dicotyledons, 1001.
Filamentous nuclei, 687.

Filicineæ, histology of, 667.
Filter for micro-chemical analysis, 678.
Finer changes in the walls of varicose veins, 877.
Fish embryology, 916.
Fission, 978.
Fixation by osmic acid and chrome-platinum solution, 883.
Fixing methods for fish ova, 916.
Flea's eggs, 947.
Flemming's solution, 1014.
Flexibility of diatom shells, 991.
Floral development in angiosperms, 741.
Floral organization of Balanophoracees, 872.
Formaldehyde as a disinfectant in the sick room, 1069.
Formalin and vapor, use of very dilute, 963.
Formulæ:
  Brass' solution, 1015.
  Chloride of iron hæmatoxylin stain for nuclei and fibrin, 1037.
  Differential stain for connective tissue, fibrillar and reticulum, 1036.
  Erlecki's solution, 979, 1015.
  Flemming's solution, 1014.
  Gilson's mercuric nitric mixture, 883.
  Glychæmalum (acid hæmalum), 779.
  Hæmacalcium, 779.
  Hæmalum, 777.
  Light Filter, 869.
  Methyl Blue, 1073.
  Muchæmatein, 779.
  Perenyi's solution, 916, 1015.
  Phosphotungstic acid hæmatoxylin for neuroglia fibers, 1038.
  Picro-nigrosin, 799.
  Rabl's picro-sublimate, 1010.
  Weigert's stain, 958.
Foul brood of bees, 1103.
Fresh water aquaria, 995.
Fuligo varians, cell and nuclear division in, 1030.
Galactase, the cheese ripening enzyme, 811.
Galls, development and morphology of, 905.
Ganomalite, 1106.
Giacomini's, method for making dry brain preparations, 706.
Giant nuclei, 688.
Gilson's mercuric nitric mixture, 883.
Ginkgo biloba L., 937.
Ginkgo biloba L., multiplication of sporangia in, 1002.
Glass cell, a quickly made, 990.
Glaucochroite, 1105.
Glioma of the lower cervical region of the spinal cord, 707.
Glycerin jelly mounts, 1043.
Glychæmalum, 779.
Gnetum, life history of, 758.
Goniometer, two-circle, 770.
Graftonite, 1106.
Gymnosperms, histology of, 734.
Gymnosperms, morphology of, 902, 1000.
Gypsum, crystallization of, 1072.
Hæmacalcium, 779.
Hæmalum stain, 777.
Hæmatein, preparation of, 1056.
Hæmatococcus, experiments on preparation of, 1019, 1020.
Hæmatoxylin stain, 779.
Hancockite, 1105.
Hemlock spruce, development of archegonium and fertilization in, 1064.
Hermetically sealed tubes, permanent preparations in, 694.
Histogenesis of peripheral nerves, 767.
Histology, normal and morbid, and histological technique, 813.
Histology, normal and pathological, reviews, 699, 765, 813, 842, 875, 940, 977, 1036, 1099.
Histology of acute lobar pneumonia, 977.
Histology of nervous system of insects, 845.
Human embryos, 979.
Hybridization of corn, 904,
Hydroids from Woods Holl, 810.
Hydromica, 847.
Identity of bacillus lactic ærogenes and Friedlander's pneumo-bacillus, 1008.
Immunity against malarial infection, 810.
Infection, 1007.
Influence of direction of light on division of Equisetum spores, 976.
Infusoria, 946.
Ink for writing on glass, 893.
Inland biological laboratories, 1044.
Innervation of the bladder, 879.
Internal secretion, 1032.
Intracellular sap canals in different kinds of cells, 1033.
Invertebrates, preparation of, for microscopical study, 792.
Investigations at Cold Spring Harbor, 993.
Iodin solution for etching steel, 1024.
Ion-proteid compounds and their role in the mechanism of life phenomena, 841.
Ions, effect of, upon aggregation of flagellated Infusoria, 763.
Iron alum, staining prothallia with, 670.
Irrigating apparatus for celloidin sectioning, 994.
Irritability of motor nerves at different points in their course, 769.
Jeffersonite, 914.
Kjeldahl's method for nitrogen determination, 812.
Kukenthal's method of staining in serial work, 674.
Labeling cover-glasses for the identification of sections, 900.
Labeling tissues for celloidin and paraffin infiltration, 894.
Laboratory, biological, of Western Reserve University, 949.
Laboratory for micro-chemical analysis, 719.
Laboratory note-book, 887.
Laboratory of physiology in the Peter Cooper high school, 918.
Laboratory photography:
  Blue prints, 835.
  Naturalist's outfit, 748.
  New apparatus for instantaneous photomicrography, 797.
  Photographing with a vertical camera, 935.
  Photo-micrographic room and apparatus in the anatomical laboratory of the Johns Hopkins University, 866.
  Ray filter, 681.
Laboratory, photo-micrographic, 684.

Leaves of angiosperms, histology of, 746.
Leaves of gymnosperms, histology of, 737.
Lenticels, 1063.
Lesion in actinomycosis, with a few new stains for the actinomyces, 1051.
Leucite, 848.
Leucophœnicite, 1106.
Leueosphenite, 1042.
Libraries of microscopical slides, 970.
Library expedients in microscopy, 1065.
Light filter in photo-micrography, 869.
Liver-cavernoma, structure and genesis of, 1100.
Lorenzite, 1042.
Luminous eggs, 947.
Lycopodineæ, histology of, 673.
Maceration medium for plant tissues, 1042.
Magnetism in embryology, 979, 1104.
Malaria in Italy, 1068, 1069.
Manganocalcite, 911.
Manipulation of chick embryos, 1010.
Marine Biological Laboratory at Woods Holl, announcement of 13th session, 837.
Mayer's hæmalum, staining prothalia with, 669.
Measuring crystals, 912.
Medusæ, preservation of, 978.
Melite, 882.
Metallography, 1023.
Metals, microscopical study of, 786.
Method for preparing small marine invertebrates for microscopical study, 792.
Method of procuring ribbons with a microtome working horizontally, 987.
Method, vialletous, 1011.
Methods:
- Anærobic cultivation in fluid media, 1006.
- Classification of slides, 970.
- Counting red blood corpuscles, 1028.
- Demonstration of canaliculi in bone, 696.
- Demonstration of lacunæ and canaliculi in bone, 843.
- Demonstration of primitive fibrillæ, 707.
- Double staining of spores and bacilli, 1005.
- Examination of sputum suspected of containing tubercle bacilli, 1073.
- Examination of uterine scrapings, 1099.
- Fixing fish ova, 916.
- Flooding the microtome knife with alcohol, 994.
- Frog embryology, 883.
- Histology of acute lobar pneumonia, 977.
- Injecting annelids, 946.
- Making biological charts, 1059.
- Making dry brain preparations, 706.
- Measuring crystals with two-circle goniometer, 770.
- Mounting Ascarus megalocephala in toto, 1012.
- Mounting blastoderm in toto, 1010.
- Mounting young chick embryos in toto, 1010.
- Nitrogen determination in milk and cheese, Kjeldahl's, 812.
- Orienting and imbedding in paraffin, 888.
- Paraffin infiltration, 897.
- Preparation and study of microscopic organisms, 1013.
- Preparation of celloidin sections, embracing albumen fixative method, 845.
- Preparation of class material, 894.
- Preparation of dry specimens of brain, 880.
- Preparation of embryo-sac of grasses, 718.
- Preparation of hæmatein, 1056.
- Preparation of Limulus eggs for study of centrosome and yolk nucleus, 807.
- Preparation of material for study of germinating spores and conidia in smuts, 803.
- Preparation of neuroglia, 877.
- Preparation of permanent mounts of spermatozoa, 980.
- Preparation of plasma cells for study, 815.
- Preparation of Rotifera, 979.
- Preparation of sense organs of nereis virens, 816.
- Preparation of small marine invertebrates for microscopical study, 792.
- Preparation of specimens for exhibition in museum or for class demonstration, 694.
- Preparation of vegetable epidermis for study of stomata, 988.
- Preservation of material with formalin, 963.
- Procuring ribbons with a microtome working horizontally, 987.
- Rapid determination of feldspar in rocks, 881.
- Staining:
  - Chloride of iron hæmatoxylin for nuclei and fibrin, 1037.
  - Differential stain for connective tissue fibrillar and reticulum, 1036.
  - Phosphotungstic acid hæmatoxylin for neuroglia fibres, 1038.
- Staining nervous system of Turbellaria, 993.
- Staining neuroglia fibres, 876.
- Staining sections while imbedded in paraffin, 695.
- Sterilizing instruments during bacteriological autopsy work, 964.
- Study of embryology of Taxus baccata L., 973.
- Study of physiology, 926.
- Study of Plasmodiophora brassicæ, 972.

Methods and manipulation of apparatus in micro-chemical analysis, 849.
Methods for preparation and study of microscopic organisms, 1013.
Methods in plant histology:
- XI. Pteridophyta: Filicineæ, Equisetineæ, Lycopodineæ, 667.
- XII. Spermatophytes: gymnosperms, angiosperms, 734.

Meteorites, 848.
Micro-chemical analysis:
- II. Arrangement and equipment of the laboratory: tables, microscopes, 719.
- III. Apparatus, 793.
- IV. Reagents for inorganic qualitative analysis, 817.
- V. General methods and manipulation of apparatus: solution, decantation, filtration, precipitation, sublimation, 849.

VI. Manipulation of apparatus: determination of crystal angles, optical properties, etc., 965.
VII. Analytical reactions of Group I. Na, K, Rb, Cs, NH_4, Li., 981.
VIII. Sodium (continued), 1045.
IX. Potassium, 1077.
Microscope for micro-chemical analysis, 723.
Microscope in primary schools, 713.
Microscope in secondary schools, 895.
Microscopic organisms, preparation and study of, 1013.
Microscopical study of metals, 786.
Microscopy and micro-technique, 808.
Micro-structure of alloys, 910.
Milk, effect of pressure on preservation of, 701.
Milk glands, anatomy and physiology of, 694.
Mineralogical literature, reviews, 708, 770, 847, 881, 911, 942, 1041, 1071, 1105.
Minerals, color of powdered, 1071.
Minerals from Swaziland, 942.
Minnesota plant life, 692.
Mitosis in Noctiluca miliaris and its bearing on the nuclear relations of Protozoa and Metazoa, 762.
Monazites, 1072.
Monoclinic system, transformation of, 945.
Morphology of gymnosperms, 902, 1000.
Moth larvæ, relation between color and food plants, 947.
Motion in plants, 948.
Motion in spermatozoa, 980.
Mounting antennæ of flies, wasps, and bees, 1043.
Mounting in glycerin, 961.
Mounting media especially adapted to plant tissues, 711.
Mounting media for vegetable epidermis, 988.
Mounting rhizopod shells, 890.
Mounting young chick embryos in toto, 1010.
Movements of bacteria in liquid suspension on passage of constant current, 702.
Movements of pollen tube, 905.
Muchæmatein stain, 779.
Müllerite, 882.
Multiple amyloid tumors of the upper air passages, 977.
Muscle cells, 695.
Mycetozoa and some questions which they suggest, 804.
Naphthalin as a protective for collections of insects, 915.
Narsarsukite, 1042.
Nasonite, 1106.
Naturalist's photographic outfit, 748.
Neuroglia, evolution and differentiation of, 877.
Neurological literature, reviews, 704, 767, 815, 844, 877, 909.
New Jersey state microscopical society, November meeting of, 1074.
New stain for neuroglia fibres, 876.
New technic for staining the tubercle bacillus, 898.
New York State Science Teachers' Association, fourth annual meeting, 662.
Note on cement for Berkefeld filter, 959.
Notes on biological section of fourth annual meeting of N. Y. State Sc. Teachers' Ass., 665.
Notes on class methods, 894.
Notes on preparation of hæmatein staining solution and the technique of staining, 1056.
Nuclear phenomena in certain stages in the development of smuts, 803.
Oaks, key to, based on the staminate flowers, 1000.
Objectives and condensers in practicable photo-micrography, 753.
On preparing earthworms for sectioning, 680.
On the enumeration of nucleated red blood corpuscles, 1028.
On the histology of the amnion, 956.
On the preparation of vegetable epidermis for the study of the stomata, 988.
On the rapid conversion of hæmatoxylin into hæmatein in staining reactions, 777.
Oögenesis in gymnosperms, 735.
Organography of plants, 1093.
Orientation in imbedding, 884.
Orienting and imbedding in paraffin, 888.
Origin and early development of flowers in cherry, plum, apple, and pear, 802.
Origin and phylogenesis of the accessory nerve, 879.
Origin of gases released by heating minerals and meteorites, 942.
Origin of nerves which inhibit action of heart in fishes, 816.
Otoliths, control of motion by, 706.
Outlines of plant life, 839.
Ova of fresh water planarians, 934.
Ovarian egg in Limulus, 807.
Ovocytes in the cat, 1033.
Oxidation of living substances, the nucleus, the chief organ in, 910.
Paraffin, to purify and harden, 947.
Paraffin infiltration, 897.
Paramœcium, experiments on preparation of, 1019–1021.
Parasite, the supposed cause of epilepsy in a boy, 1089.
Parthenogenesis in Marsilea and its independence of temperature, 873.
Perenyi's solution, 916, 1015.
Peripheral nerves, histogenesis of, 767.
Peritoneal epithelium in inflammation, 699.
Permanent mounts of spermatozoa, 980.
Petroleum in quartz crystals, 942.
Phenocrysts in intrusive igneous rocks, 708.
Photographing with a vertical camera, 935.
Photomicrographic room and apparatus in the anatomical laboratory of the Johns Hopkins University, 866.
Photomicrographs of diatoms, etc., 712.
Photomicrography, apparatus for instantaneous, 797.
Photomicrography, practicable, 683.
Phosphorescent fungi, 948.
Physiological effects of extracts of pituitary body, 707.
Physiology in the Peter Cooper High School, New York City, 917.
Picro-nigrosin stain for cell structures, 799.
Sublimate, Rabl's, 1010.
Sulphuric acid, 883.
Plagioclase feldspars in rock sections, 710.
Plague, bubonic, 1071.
Plant structures, a second book in botany, 759,

Plasma cells, 766.
Plasmodiophora brassicæ, structure and development of, 972.
Pneumonia, termination of, in induration, 765.
Point in the technique of the Cox-Golgi staining method, 674.
Poisonous character of a pure NaCl solution, 841.
Polychromatophilous degeneration of red corpuscles, 765.
Polypterus lechir, premaxillary and maxillary bones, and the maxillary and mandibular breathing valves of, 1098.
Portable blast lamp, 986.
Potassium, 1077.
Practical metallography, 1023.
Photomicrography, I, 683, II, 753.
Preparation and study of micro-organisms, 1013.
Of metal sections, 790.
Of seeds for study, 1042.
Preservation of stock cultures, 780.
Primitive fibrillæ, demonstration of, 707.
Prosopite, 914.
Prothallia: Filicineæ, 667; Equisetineæ, 672.
Protoplasm, 697.
Streaming movements of, 946.
Protoplasmic connection between the parts of the segmented egg, 846.
Protoplasmic continuity between cells, 1095.
Psammona, 876.
Pteridophyta, histology of, 667.
Puff balls, slime moulds and cup fungi of Orleans Co., N. Y., 872.
Rabies, 1008.
Raja batis, continuity of germ-cells in, 1095.
Rana fusca and R. esculenta, influence of temperature upon development of, 1011.
Ray filter in laboratory photography, 681.
Reagents for inorganic qualitative analysis, 817.
Reagents for milk proteids, 812.
Reisner's fibers in the canalis centralis of vertebrates, 806.
Regulation of water supply in Arnold steam sterilizers, 715.
Relaxing insects, 915.
Repair after suturing of arteries, 1100.
Report blank in collection of specimens for bacteriological examination, 826.
Reproduction in algæ, chemical and physical factors in, 690.
Rhizome, preparation of, 671.
Rhizopod shells, mounting, 890.
Rhizopods, 1043.
Rhubarb grown in the dark, 723.
Ribbons with a microtome working horizontally, 987.
Riebeckite in trachytic rocks, 942.
Roof and lateral recesses of the fourth ventricle, morphology and embryology of, 844.
Root tubercles in leguminous plants, 1007.
Roots and stems of angiosperms, histology of, 746.
Roots and stems of gymnosperms, histology of, 739.
Roscœlite, chemical constitution of, 710.
Rotifera, 946, 979.
Rotifers, to kill, 1043.
Rubiaceæ, comparative embryology of, 689.
Saururus cernuus, development of, 1002.
Sausage, bacterial poison in, 1070.
Schizolite, 1042.
Schwalbe's method of preparing dry specimens of brains, 880.
Sea urchin, 1011.
Sea urchin, artificial production of normal larvæ from unfertilized eggs, 1034.
Sense organs of Nereis virens, 815.
Sequoia sempervirens, development of endosperm in, 1030.
Serial sections, arrangement of, 1058.
Serous gland cells, structure of, 1004.
Sexuality of fungi, 804.
Sexuality of lichens, 840.
Silico-aluminate, artificial, 708.
Silphium, life history of, 903.
Simple apparatus for obtaining plate cultures or surface growths of obligative anærobes, 811.
Skeleton, mammalian, comparative study of, 926.
Skin diseases observed in Indianapolis, unusual cases, 1006.
Slides for micro-chemical work, 793.
Slime moulds, 998.
Slime moulds, the North American, 692.
Snail, nervous system of, 768.
Snails' eggs, 979.
Snails, observations upon, 970.
Society of American Bacteriologists, organization of, 661.
Sodium, 982, 1045.
Soil bacillus of the type of De Bary's B. megatherium, 703.
Soil bacteria, new species, 1008.
Source of the fibrin and the origin of the adhesions in acute adhesive inflammation of serous surfaces, 875.
Sparganium, flower and embryo of, 689.
Spencer, Herbert R., life of, 757.
Spermatogenesis in angiosperms, 742.
In gymnosperms, 734.
Spermatophytes, histology of, 734.
Spermatozoa of Polyphemus pediculus, 980.
Spider cocoons, 914.
Spiders, 947.
Spodiophyllite, 1042.
Spore bearing members in Filicineæ, morphology of, 1063.
Sporophyte of Filicineæ, histology of, 670.
Spring clip, for cover-glass, 991.
Stain for nervous system of the Turbellaria, 993.
Stain to demonstrate the coleoderm of diatoms, 915.
Staining sections, 712.
The envelope of certain ascospores, 781.
The tubercle bacillus, 898.
Stains for actinomyces, 1051.
Stems and roots of angiosperms, histology of, 746.
Stems and roots of gymnosperms, histology of, 739.
Sterilizing instruments during bacteriological autopsy work, 964.
Stock culture and color preservation, 780.
Straightening crinkled paraffin sections, 733.

Stylidiaceæ, morphology of, 1093.
Substage, duplex, 933.
Syllabus of elementary physiology with references and laboratory exercises, 978.
Synthetic alcohol as a fixing agent for tissues, 1061.
Systematic bacteriology, 1008.
Table, biological laboratory, 952.
For micro-chemical work, 720.
Of properties of organisms isolated from gastric mucosa of cat, 677.
Tainiolite, 1042.
Taxonomic value of the staminate flowers of some of the oaks, 1000.
Taxus baccata L., embryology and development of, 973.
Technique in study of polychromatophilous degeneration of red corpuscles, 766.
Temperature and rhythm, 911.
Termination of pneumonia in induration, 765.
Theories concerning significance of the vesicle in embryos of bony fishes, 974.
Thermofore, for removing bacteria from milk, 1101.
To prevent sections from drying, 666.
Tobacco, culture and biology of, 1103.
Toxic effect of deleterious agents on the germination and development of certain filamentous fungi, 871.
Triglochin maritimum L., structure and development of, 903.
Tubercle bacillus, heat death point of, 1040.
In butter and margarine, 1040.
In cold blooded animals, 1039.
In human milk, 1040.
In milk, 703.
Tumors, etiology of, 941.
Typhoid and colon bacilli, differences, 1104.
Typhoid bacillus in the urine, 704.
Typhoid fever and its bacillus, 1009.
Tysonite, 914.
Unna's method for staining plasma cells, 815.
Uranium, 847,
Urobilin in urine, 1074.
Use of microscope in secondary schools, 895.
Use of very dilute formalin and vapor, 963.
Useful method of staining, 674.
Vacuolated nuclei, 687.
Variability in the power of milk bacteria to liquify gelatin, 702.
Variability of milk bacteria with relation to fermentation, 1039.
Varicose veins, changes in the walls of, 877.
Vaucheria, 1042.
Venation in the wings of insects, 947.
Vesicle in embryos of bony fishes, 974.
Vialletous method, 1011.
Vials for micro-chemical reagents, 823.
Villi of human intestine, development of, 840.
Virulence of tubercle bacillus in frogs, 1039.
Vorticella, experiments on preparation of, 1020.
Vorticella and Conochilus as commensals, 989.
Wall charts, biology, 1059.
Water bath, 693.
Water of crystallization, nature of, in salts, 709.
Weigert's new stain for elastic fibers, 958.
Whole mounts of hydroids, 712.
Widal-Gruber reaction with dried blood, 885.
Widal reaction, blood dilution in, 961.
Zoizite, 848.

INDEX OF AUTHORS.

BABCOCK, W. WAYNE.
The Best Material for Blocks upon which to Mount Tissues Embedded in Celloidin, 1090.

BARBOUR, ERWIN H.
Photography in the Bad Lands of Nebraska and South Dakota, 748.

BAUSCH, EDWARD.
The Duplex Substage, 933.

BAUSCH, H.
A Simple Apparatus for Drawing Objects Natural Size, 891.

BENEDICT, A. L.
The Camera Lucida in Blood Counting, 1087.

BIGNEY, A. J.
Libraries of Microscopical Slides, 970.

BIOLETTI, FREDERIC.
Regulation of the Water Supply in Arnold Steam Sterilizers, 715.

BRACE, EDITH M.
Bibliographies, 717.
Neurological Literature, 704, 767, 815, 844, 877, 909.

BRITTON, W. E.
The Ray Filter in Laboratory Photography, 681.

BROOKOVER, CHAS.
A Method of Procuring Ribbons with a Microtome Working Horizontally, 987.

BRYAN, G. H.
Cleaning Desmids, 1026.

CANNON, WM. A.
The Antipodal Cells in the Embryo-sac of Grasses, 718.

CHAMBERLAIN, CHAS. J.
Current Botanical Literature, 687, 758, 801, 839, 871, 902, 937, 972, 998, 1030, 1063, 1093.
Methods in Plant Histology.
XI. Pteridophyta, 667.
XII. Spermatophytes, 734.

CHAMOT, E. M.
Micro-chemical Analysis.
II. The Arrangement and Equipment of the Laboratory, 719.
III. Apparatus, 793.
IV. Reagents for Inorganic Qualitative Analysis, 817.
V. General Methods and Manipulation of Apparatus, 849.
VI. Manipulation of Apparatus (continued), 965.
VII. The Analytical Reactions of Group I, 981.
VIII. Sodium (continued), 1045,
IX. Potassium, 1077.

CHESTER, F. D. and ROBIN, A.
Blood Dilutions in the Widal Reaction, 961.

CLAYPOLE, A. M.
Cytology, Embryology and Microscopical Methods, 693, 761, 805, 840, 874, 906, 974, 1003, 1032, 1065, 1095.
The American Society of Naturalists, 657.

CLEMENT, ARTHUR G.
The Use of the Microscope in the Secondary Schools, 895.

CONN, H. W.
Current Bacteriological Literature, 1005, 1039, 1068, 1101.

DENNE, M. T.
A Method of Orienting and Imbedding in Paraffin, 888.

DINWIDDIE, ROBERT R.
The Application of the Widal-Gruber Reaction with Dried Blood, 885.

DOTY, H. A.
A Quickly Made Glass Cell, 990.
Conochilus and Vorticella as Commensals, 989.
Spring Clip, 991.
The Flexibility of Diatom Shells, 991.

ELROD, MORTON J.
Methods for the Preparation and Study of Microscopic Organisms, 1013.

EVANS, NEWTON.
Canada Balsams for Ringing Slides, 1060.

EYRE, J. W. H.
The Bacteriological Department of Charing Cross Hospital, Eng., 824.

FREEBORN, GEORGE C.
Notes on the Preparation of Hæmatein Staining Solution and on the Technique of Staining, 1056.

FRENCH, G. H.
A Parasite, the Supposed Cause of Epilepsy in a Boy, 1089.

HARRIS, H. F.
On the Rapid Conversion of Hæmatoxylin into Hæmatein in Staining Reactions, 777.

HEALD, F. D.
A Method of Making Biology Wall Charts, 1059.

HERRICK, F. H.
Biological Laboratory of Western Reserve University, 949.

HERZOG, MAXIMILIAN.
On the Histology of the Amnion, 956.
Weigert's New Stain for Elastic Fibers, 958.

HICKEY, P. M.
Irrigating Apparatus for Celloidin Sectioning, 994.

HILL, HIBBERT W.
Sterilizing Instruments During Bacteriological Autopsy Work, 964.

HUBBERT, W. R.
Note on Cement for Berkefeld Filters, 959.

JOHNSON HERBERT P.
A Method of Preparing Small Marine Invertebrates for Microscopic Study, 792.

JULIEN, FANNY.
The Microscope in the Primary Schools, 713.

KRAUSS, WM.
A Convenient Source of Artificial Light for the Laboratory Table, 1086.

LATHAM, V. A.
A Useful Method of Staining, 674.

MARTIN, GEO. W.
Biology in Secondary Schools, 859.

MCFARLAND, JOSEPH.
Bacteriological Instruction in Medical Schools, 1084.

MORGAN T. H.
Action of Salt Solutions upon Eggs, 945.

MORSE, W. J.
A Portable Blast Lamp, 986.

MOSES, ALFRED J., and LUQUER, LEA MCI.
Notes on Recent Mineralogical Literature, 708, 770, 847, 881, 911, 942, 1041, 1071, 1105.

MURBACH, L.
Fresh Water Aquaria, 995.
The Use of Very Dilute Formalin and Vapor, 963.

NICHOLS, J. B.
A Point in the Technique of the Cox-Golgi Staining Method, 674.
On the Enumeration of Nucleated Red Blood Corpuscles, 1028.

OERTEL, T. E.
Synthetic Alcohol as a Fixing Agent for Tissues, 1061.

OSBORN, H. L.
Devices for Exhibition of Objects in the Teaching Museum, 1053.

PALMER, T. C.
Stain to Demonstrate the Coleoderm of Diatoms, 915.

PEABODY, JAMES E.
New York State Science Teachers' Association, 662.
Physiology in the Peter Cooper High School, New York City, 917.

PEARCE, RICHARD M.
Normal and Pathological Histology, 699, 765, 813, 842, 875, 940, 977, 1036, 1099.

PEARL, RAYMOND.
On Preparing Earthworms for Sectioning, 680.

PENDERGAST, NELLIE B.
Mounting Rhizopod Shells, 890.

PIERCE, NEWTON B.
Stock Cultures and Color Preservation, 780.

POTTER, CHAS. H.
Practicable Photomicrography, 683, 753.

RILEY, WM. A.
Arrangement of Serial Sections, 1058.
Staining the Envelope of Certain Ascospores, 781.

ROBIN, A., and CHESTER, F. D.
Blood Dilutions in the Widal Reaction, 961.

ROSENBERGER, RANDLE C.
New Technic for Staining the Tubercle Bacillus, 898.
The Lesion in Actinomycosis with a Few New Stains for the Actinomyces, 1051.

SAVAGE, GEORGE H.
A Filter for Microchemical Analysis, 678.

SCHAFFNER, JOHN H.
A Differential Stain for Cell Structures, 799.
Mounting in Glycerin, 961.
The Laboratory Note Book, 887.

SHORE, CLARENCE A.
Notes on Class Methods, 894.

SCOTT, A. C.
A New Apparatus for Instantaneous Photo-micrography, 797.

STINE, WILBUR M.
The Microscopic Study of Metals, 786.

THURSTON, C. M.
Labeling Cover-glasses for the Identification of Sections, 900.
Labeling Tissues for Celloidin and Paraffin Infiltration, 894.
Method for Paraffin Infiltration, 897.

WAITE, H. H.
Current Bacteriological Literature, 701, 810.

WEISS, JULIUS.
The Bacteria in the Stomach of the Cat:
II. 675.
III. The Behavior of Bacteria in the Presence of Different Strengths of Combined and Free Acids, Associated in Digestion, 724.
IV. 782.
V. Experiments in the Present Investigation, 827.

WOODFORD, R. P.
On the Preparation of Vegetable Epidermis for the Study of the Stomata, 988.
To Prevent Sections from Drying, 666.

INDEX OF AUTHORS REVIEWED.

ABBA AND RONDELLI.
Weitere behufs Disinfektion von Wohnräumen mit dem Flügge'schen und dem Schering'schen formogenen apparat ausgeführte Versuche, 1069.

ABRAMOW.
Ueber die Veränderungen der Blutgefässe bei der Syphilis, 814.

ALLIS, E. P.
The Lateral Sensory Canal of Polypterus, 909.

ALLIS, EDW. P., JR.
The Premaxillary and Maxillary Bones, and the Maxillary and Mandibular Breathing Valves of Polypterus lechir, 1098.

AMANN, JULES.
Neue Beobachtungsmedien, 711.

ARGUTINSKY, P.
Eine einfache und zuverlässige Methode Celloidinserien mit Wasser und Eiweiss aufzukleben, 845.

ARNOLDI, W.
Beiträge zur Morphologie der Gymnospermen, IV. Was sind die "Keimbläschen" oder "Hofmeister's-Körperchen" in der Eizelle der Abietineen, 902.
Beiträge zur Morphologie der Gymnospermen, III. Embryogenie von Cephalotaxus fortunei, 1000.
Die Entwickelung des Endosperms bei Sequoia sempervirens. Beiträge zur Morphologie einiger Gymnospermen, I, 1030.

ATHERTON, LEWIS.
The Epidermis of Tubifex rivulorum Lamark, with especial Reference to its Nervous Structure, 706.

AUCHÉ ET HOBBS.
De la tuberculose chez la Grenouille, 1039.

BABCOCK, S. M., RUSSELL, H. L., VIVIAN, A., AND HASTINGS, E. G.
The Action of Proteolytic Ferments on Milk, with Special Reference to Galactase, the Cheese Ripening Enzyme, 811.

BACKHAUS AND APPEL.
Ueber aseptische Milchgewinnung. Berichte des Landwirtschaftlichen, 1007.

BAIL.
Versuche über eine Möglichkeit der Entstehung von Fleischvergiftungen, 1070.

BALICKA-IWANOWSKA, GABRIELLE.
Contribution a l'etude du sac embryonnaire chez certain Gamopetales, 802.

BARNES, C. R.
Outlines of Plant Life, with Special Relation to Form and Function, 839.

BASSETT, V. H.
Examination of Milk for Tubercle Bacilli, 703.

BEARD, J.
The Morphological Continuity of the Germ Cells in Raja batis, 1095.

BECKER, GEORGE F.
Determination of Plagioclase Feldspars in Rock Sections, 710.

BELAJEFF, WL.
Ueber die Cilienbildner in den spermatogenen Zellen, 687.

BERRY, J. M.
On the Development of the Villi of the Human Intestine, 840.

BETHE, A.
Demonstration of Primitive Fibrillæ, 707.

BIEL, A. F.
Movements of Bacilli, etc., in Liquid Suspension on Passage of Constant Current, 702.

BLAKE, JOS. A.
The Roof and Lateral Recesses of the Fourth Ventricle, considered Morphologically and Embryologically, 844.

BONHOFF.
Ueber das Vorkommen von Tuberkelbacillen in der Marburger Butter and Margarine, 1040.

BOWER, F. O.
Studies in the Morphology of Spore-producing Members, 1063.

BOWMAN, H. L.
Beiträge zur Kentniss des Monazits, 1072.

BRAND, F. VON.
Cladophora studien, 873.

BRAYTON, A. W.
Several Unusual Cases of Skin Diseases Observed in Indianapolis, 1006.

BREUSING, EDUARD.
Untersuchungen über Breithaupt's Manganocalcit (Agnolith Breusing), 911.

BULLOCK, W.
A Simple Apparatus for Obtaining Plate Cultures or Surface Growths of Obligative Anærobes, 811.

BURNS, G. P.
Beiträge zur Kentniss der Stylidiaceen, 1093.

BUTTNER, F.
Investigations into the Role of the Peritoneal Epithelium in Inflammation, 699.

CALKINS, G. M.
Mitosis in Noctiluca miliaris and its Bearings on the Nuclear Relations of Protozoa and Metazoa, 762.

CAMPBELL, D. H.
A Peculiar Embryo-sac in Peperomia pellucida, 804.
Die Entwickelung des Embryosaches von Peperomia pellucida, Kunth, 871.
Lecture on the Evolution of Plants, 688.
Studies on the Araceæ, 937.
Studies on the Flower and Embryo of Sparganium, 689.

CELAKOVSKI, L. J.
Die Vermehrung der Sporangien von Ginkgo biloba L., 1002.

CELLI.
Beitrag zur Erkentniss der Malariaepidemiologie vom neuesten ätiologischen Standpunkte aus, 1068.
Die neue Prophylaxis der Malaria im Latium, 1104.
Ueber Immunität gegen Malariainfektion, 810.

CHESTER.
I, Studies in Systematic Bacteriology; II, Description of New Species of Soil Bacteria, 1008.

CLARK, J. F.
On the Toxic Effect of Deleterious Agents on the Germination and Development of Certain Filamentous Fungi, 871.

CLARKE, F. W., AND DARTON, N. H.
Hydromica from New Jersey, 847.

COLQUHOUN, W.
Some Experiments on Bone, with Methods of Demonstrating the Canaliculi, 696.

CONN, H. W.
Variability in the Power of Liquefying Gelatin Possessed by Milk Bacteria, 702.
Classification of Dairy Bacteria, 1008.

CONRAD, A. H.
A Contribution to the Life History of Quercus, 999.

COULTER, J. M.
Plant Structures, a Second Book in Botany, 759.

COX, U. O.
A Syllabus of Elementary Physiology with References and Laboratory Exercises, 978.

CREIGHTON, C.
Chick's Amnion—Allantois, 1003.

CULLEN, T. S.
Cancer of the Uterus: its Pathology, Symptomatology, Diagnosis and Treatment, 1099.

D'ACHIARDI, G.
Analcite, Optical Anomalies of, from Montecatini, 914.

DARBYSHIRE, O. V.
Ueber die Apothecienentwickelung der Flechte Physcia pulverulenta (Schreb) Nyl., 840.

DAVIS, B. M.
The Fertilization of Albugo candida, 938.

DEAN, B.
Development of Bdellostoma storeti, 1004.

DEVAUX, M. H.
Recherches sur les lenticelles; étude sur les conditions physiologiques de l'accroissement et de la differenciation de la cellule et des tissus, 1063.

DE VRIES, H.
Sur la fécundation hybride de l'endosperme chez le mais, 904.

DUNHAM, E. K.
Histology, Normal and Morbid, 813.

EDES, R. T.
Temperature and Rhythm, 911.

EICKHOFF, K.
Ueber die Erregbarkeit der Motorischen Nerven an Verschiedenen Stellen ihres Verlaufes, 769.

EIGENMANN, C. H.
The Eyes of the Blind Vertebrates of North America. I, The Eyes of the Amblyopsidæ, 767.

EISEN, G.
On the Blood Plates of the Human Blood, with Notes on the Erythrocytes of Amphiuma and Necturus, 761.

ELLIOTT, G. R.
Notes on Laboratory Methods, 706.

FAIRMAN, C. E.
Puff Balls, Slime Moulds and Cup Fungi of Orleans Co., N. Y., 872.

FARRINGTON, O. C.
Average Specific Gravity of Meteorites, 848.

FEDOROW, E. VON.
Weiss'sches Zonengesetz und neue Krystallographie, 881.

FÉRÉ, C. H.
Abnormalities in Development of Chick, 976.

FREUDENREICH.
Reift der Hartkäse gleichmässig durch die ganze Masse, oder von aussen nach innen, 1103.

FRIEDEL, G.
Analyse d'un silicate d'aluminum et de sodium artificial, 708.
Nouveaux essais sur les Zéolithes, 711.
Sur un nouveau silico-aluminate artificial, 708.

FRIEDEL, G, AND CUMENGE, E.
Sur un nouveau mineral d' urane, 847.

FRY, E. D. C. L.
The Mycetozoa and Some Questions which they Suggest, 804.

GABRITSCHEWSKY.
Ueber active Beweglichkeit der Bakterien, 1041.

GARNIER, C.
Structure of Serous Gland Cells, 1004.

GARREY, W. E.
The Effect of Ions upon the Aggregation of Flagellated Infusoria, 763.

GOEBEL, K.
Organography of Plants, especially of the Archegoniatæ and Spermaphyta. Part I, General Organography, 1093.

GOFF, E. S.
The Origin and Early Development of the Flowers in the Cherry, Plum, Apple and Pear, 802.

GOLDSCHMIDT, V.
Goniometer mit zwei Kreisen, 770, 945.
Ueber Krystallssysteme, deren Definition und Erkennung, 943.

GRASSI.
Erster summarischer Bericht über die Versuch zur Verhütung der Malaria, angestellt in der Gegend von Pæstum, 1069.

GRIMBERT ET LEGROS.
De l'indentite du bacillus lactis ærogenes et de pneumo-bacille de Friedlander, 1008.

GRUENSTEIN, N.
Zur Innervation der Harublase, 879.

GURWITSCH, A.
Zur Entwickelung der Flimmerzellen, 805.

HAECKER, V.
Praxis und Theorie der Zellen und Befruchtungslehre, 695.

HAMMAR, J. A.
Ist die Verbindung zwischen den Blastomeren wirklich protoplasmatische und primaer? 846.

HANKIN.
On the Detection of the Bacillus typhi abdominalis in Water and other Substances, 1009.

HARDY, W. B.
Structure of Cell Protoplasm. Part I, The Structure Produced in a Cell by Fixative and Postmortem Changes. The Structure of Colloidal Matter and the Mechanism of Setting and Coagulation, 697.

HARPER, R. A.
Cell and Nuclear Division in Fuligo varians, 1030.
Cell Division in Sporangia and Asci, 902.
Nuclear Phenomena in Certain Stages in the Development of the Smuts, 803.

HARRIS, H. F.
Case of Diabetes Mellitus, quickly following Mumps, 909.

HARRISON.
The Foul Brood of Bees.

HARTLEY, W. N., AND RAMAGE, H.
Meteorites, spectrographic analysis of, 848.

HEINZ.
On the Source of the Fibrin and the Origin of the Adhesions in Acute Adhesive Inflammation of Serous Surfaces, 875.

HESSE, R.
Untersuchungen über die Organe der Lichtempfindung bei niederen Thieren. V, Die Augen der polychæten Anneliden, 704.

HILL, T. G.
The Structure and Development of Triglochin maritimum L., 903.

HILLEBRAND, W. F.
Analyses of Tysonite, Bastnäsite, Prosopite, Jeffersonite, Covellite, etc., 914.

HILLEBRAND, W. F., AND TURNER, H. W.
Roscoelite, with note on its chemical constitution, 710.

HITE, B. H.
The Effect of Pressure on the Preservation of Milk, 701.

HOHNGREN, E.
Von den Ovocyten der Katze, 1033.

HOLLAND, T. H.
Barytes, Quartz Rock from Salem, Madras, 710.

HOWE, E. G.
Advanced Elementary Science, being Part II of "Systematic Science Teaching," a manual of inductive elementary work, 839.

HUDSON, W. H., BARKER, L. F., AND FLEXNER, S.
A Case of Glioma of the Lower Cervical Region of the Spinal Cord, 707.

JACOBSTHAL, H.
Zur Histologie der Arteriennaht, 1100.

JAGER, L.
Beiträge zur Kentniss der Endospermbildung und zur Embryologie von Taxus baccata L., 973.

JANNI.
The Finer Changes in the Walls of Varicose Veins, 877.

JOANNOVICS, G.
Ueber das Vorkommen, die Bedeutung und Herkunft der Unna scheu Plasmazellen bei verschiedener pathologischen Processen, 815.

JOHNSON, D. S.
On the Development of Saururus cernuus L, 1002.

JOLLY, J.
Recherches sur la value morphologique et la signification des differents types de globules blancs, 699.

KIPPING, F. S., AND POPE, W. P.
Enantiomorphism, 913.

KLEBS, G.
Zur Physiologie der Fortplanzung einiger Pilze, 690.

KLEBS, R.
Cedarite, 1072.

KLEIN, C.
Leucite and Analcite, and their Mutual Relations, 848.

KLEIN, E.
Zur Kentniss des Schicksals pathogener Bakterien in der beerdigten Leiche, 701.

KOHL, F. G.
Dimorphismus der Plasmaverbindungen, 1095.

KOLSTER.
On the Histogenesis of Peripheral Nerves, 767.

KONING.
Der Tabak, studien über seine Kultur und Biologie, 1103.

KOPSCH, FR.
Homologie und phylogenetische Bedeutung der Kupffer's scheu Blase, 974.

KREIDL, A.
Ueber den Ursprung der Hemmungsnerven des Herzens bei Fischen, 816.

KÜSTER, E.
Beiträge zur Kentniss der Gallenanatomie, 905.

LACK.
The Experimental Production of Cancer, 700.

LAND, W. J. G.
Double Fertilization in Compositæ, 1031.

LANGDON, F. E.
The Sense Organs of Nereis virens, Sars., 815.

LAUDENBACH, J.
Fur Otolithen-Frage, 706.

LIDFORSS, B.
Ueber den Chemotropismus der Pollenschläuche, 905.

LIVERSIDGE, A.
On the Crystalline Structure of Nuggets of Gold and Platinum and of Ingots of Gold, 942.

LLOYD, F. E.
The Comparative Embryology of the Rubiaceæ, 689.

LOEB, J.
On Ion-Proteid Compounds and Their Role in the Mechanics of Life Phenomena. I, The Poisonous Character of a Pure NaCl Solution, 841.
On the Artificial Production of Normal Larvæ from the Unfertilized Eggs of the Sea Urchin (Arbacia), 1034.
On the Different Effects of Ions upon Myogenic and Neurogenic Rhythmical Contractions, and upon Embryonic and Muscular Tissue, 874.
Warum ist die Regeneration kernloser Protoplasmastuecke unmoeglich oder erschwert? 910.

LONGO, B.
Osservazioni sulle Calycanthaceæ, 939.

LOTSY, J. P.
Balanophora globosa Jungh., 872.
Contributions to the Life History of the Genus Gnetum, 758.

LUBARSCH.
Ueber das Verhalten der Tuberkelpilze im Froschkörper, 1039.

MACBRIDE, T. H.
The North American Slime Moulds, 692.
The Slime Moulds, 998.

MACMILLAN, C.
Minnesota Plant Life, 692.

MAJORANA, Q.
On the Reproduction of Diamond, 913.

MALLORY, F. B.
A Contribution to Staining Methods, 1036.

MANASSE, P.
Multiple Amyloid Tumors of the Upper Air Passages, 977.

MARSCHALKO.
Plasma Cells, 766.

MARX AND WOITHE.
Morphologische Unterschungen zur Biologie der Bakterien, 1009.

MASCHKE, O., UND VATER, H.
Microscopische Studien über die Krystallisation des Gypses, 1072.

MERRELL, W. D.
A Contribution to the Life History of Silphium, 903.

MICHEL, L.
Sur une molybdénite bismuthifère, 847.

MIERS, H. A.
Mineralogical Notes, 847.

MINERVINI.
Einige bakteriologische Untersuchungen über Luft und Wasser inmitten des Nord-Atlantischen Oceans, 1070.

MOLISCH, H.
Ueber Zellkerne besonderer Art, 687.

MORGENROTH.
Versuche über Abtödtung von Tuberkelbacillen in Milch, 1040.

MUGGE, O.
Ueber Translationen und verwandte Erscheinungen in Krystallen, 1071.

MUNSON, J.
The Ovarian Egg of Limulus. A Contribution to the Problem of the Centrosome and Yolk-nucleus, 807.

MÜLLER, E.
Studien über Neuroglia, 877.

MURBACH, L.
Hydroids from Woods Holl, Mass.; Hypolytus peregrinus, a new Unattached Marine Hydroid. Coregnitis Agassizii, and its Medusa, 810.

MURRILL, W. A.
The Development of the Archegonium and Fertilization in the Hemlock Spruce (Tsuga canadensis, Carr), 1064.

NACHTRIEB, H. F.
Permanent Preparations in Hermetically Sealed Tubes, 694.

NAKANISHI.
Bacillus variabilis lymphæ vaccinalis, etc., 1104.

NATHANSON, A.
Ueber Parthenogenesis bei Marsilea und ihre Abhängigkeit von der Temperatur, 873.

NAWASCHIN, S.
Beobachtungen über den feineren Bau und Umwandlung von Plasmodiophora Brassicæ Woron, im Laufe ihres intracellularen Lebens, 972.
Embryology of Corylus, 872.
Ueber die Befruchtungs vorgänge bei einigen Dicotyledoneen, 1001, 1031.

NEWMAN.
Bacteria, especially as they are related to the economy of nature, to industrial processes, and to the public health, 1102.

NOBBE AND HILTNER.
Künstliche überfahrung der Knollchenbakterien von Erbsen in solche von Bohnen, 1007.

PARK, W. H.
Changed Appearance of Diphtheria Bacillus, 704.

PENFIELD, S. L.
Graftonite: a New Mineral from Grafton, N. H., and its Intergrowth with Triphylite, 1105.

PENFIELD, S. L., AND WARREN, C. H.
Some New Minerals from the Zinc Mines at Franklin, N. J., and note concerning the Chemical Composition of Ganomalite, 1105.

PFUHL.
Masseserkrankung nach Wurstgenuss, 1070.

PIORKOWSKI.
Ein neurer heizbares Färbetische, 693.

PIROTTA, R., AND BUSCALIONI, L.
Sulla presenza di elementi vascolari multinucleati nelle Dioscoreacee, 803.

PIRSSON, L. V.
On the Phenocrysts of Intrusive Igneous Rocks, 708.

PORTER, C. E.
Memorandum de Zoolojia conpame e los ilimos adelantos de la ciencia, 906.

PRATT, J. H.
On the Occurrence, Origin and Chemical Composition of Chromite, 710.

PRIOR, G. T.
Minerals from Swaziland: Niobates and Titanates of the rare earths, chemically allied to Euxenite and Fergusonite; Cassiterite, Monazite, etc., 942.
Riebeckite in Trachytic Rocks from Abyssinia, 942.

RADZIEVSKY.
Ueber Infection, 1007.

RAMBOUSEK.
Vergleichende und kritische Studien, betreffend die Diagnostik des Bact. typhi und des Bact. coli.

RAMSAY W., AND TRAVERS, M. W.
Fergusonite, an endothermic mineral, 882.

RANVIER, S.
Des Clasmatocytes, 906.

REESE, L.
Inclusions of Petroleum in Quartz Crystals, 942.

REMY.
Contribution a l'etude de la fievre typhöide et de son bacille, 1009.

RHUMBLER, L.
Physics of Cell Life, 1003.

RIBBERT.
On the Termination of Pneumonia in Induration, 765.

RICHARDSON, M. W.
On the Presence of the Typhoid Bacillus in the Urine, 704.

RIES, H.
Kaolins and Fire Clays of Europe and the Clay-working Industry of the United States in 1897, 848.

RINNE, F.
Beitrag zur Kentniss der Natur des Krystallwassers, 709.

ROGER AND GARMER.
Tubercle Bacillus in Human Milk, 1040.

ROGOYSKI.
Zur Kentniss der Denitrifikation und der Zersetzungs erscheinungen der Tierischen Exkremente in der Akererde, 1102.

ROWLEE, W. W., AND NICHOLS, S. P.
The Tasonomic Value of the Staminate Flowers of some of the Oaks, 1000.

RUSSELL, H. L., AND BASSETT, V. H.
Effect of Different Influences on Normal Temperature of Cattle, and Relation of same to Tuberculin Test, 703.
Effect of Digesting Bacteria on Cheese Solids of Milk, 703.

SARGANT, E.
Recent Work on the Results of Fertilization in Angiosperms, 1094.

SARGENT, P. E.
Reisner's Fibers in the Canalis Centralis of Vertebrates, 806.

SCHAFFER, J.
Zur Kentniss der glatten Muskelzellen, insbesondere ihre Verbindung, 695.

SCHATTENFROH UND GRASSBERGER.
Ueber Buttersauregährung, 1102.

SCHEFER, E. A., AND SWALE, V.
The Physiological Effects of Extracts of the Pituitary Body, 707.

SCHIERBECK.
Ueber der Variabilität der Milchsäurebacterien mit Bezug auf des Gährungsfähigheit, 1039.

SCHMIDT, H.
Ueber die Darstellung der Begleit und Gliazellen im Nerven-system von Helix, mit der Golgimethode, 768.

SCHMIEDEN.
Cirrhosis and Multiple Adenomata of the Liver, 1099.
Ueber den Bau und die Genese der Leber-cavernome, 1100.

SCHMORL, G.
Darstellung feinerer Knockenstructuren, 843.

SCHNEIDER, A.
Microscopy and Micro-technique, 808.

SCHROEDER VAN DER KOLK, J. L. C., 1071.

SCHUELLER.
A Contribution to our Knowledge of the Etiology of Tumors, 941.

SCHWARZMANN, M.
Krystallophotogrammetrie. Neues Hilfsverfahren bei der Krystallmessung, 912.

SEWARD, A. C., and GOWAN, J.
The Maidenhair Tree (Ginkgo biloba L.), 937.

SICHERER, O. v.
Zur Chemotaxis der Leukocyten in vitro, 702.

SMITH, G. F. H.
Atacamite from Sierra Gorda, Chili, 882.

SMITH, R. G.
Double Staining of Spores and Bacilli, 1005.

SMITH, S.
Note on the Staining of Sections while Embedded in Paraffin, 695.

SOMMERFELD.
Ueber die Verwendung des Milchthermophors.

STAHL, E.
Influence of Direction of Light on Division of Equisetum Spores, 976.

STANSFIELD, F. W.
On the Production of Apospory by Environment in Anthyrium Felix-fæmina, var. unco-glomeratum, an Apparently Barren Fern, 688.

STARKE, F. W.
Constitution of Arsenopyrite, 710.

STEAD, J. E.
Microstructure of Alloys, 910.

STERNBERG, C.
Cell Inclusions in Carcinomata and their Relations to the Blastomycetes, 700.

Zur Verwerthbarkeit der Agglutination für die Diagnose der Typhusbacillen, 1009.

STEVENS, F. L.
The Compound Oösphere of Albugo bliti, 801.

STRASBURGER, E.
Ueber Reduktionstheilung, Spindelbildung, Centrosomen und Cilienbildner im Pflanzenreich, 691.

STURGIS, W. C.
A Soil Bacillus of the Type of DeBary's B. Megatherium, 703.

TERMIER, P.
Zoizite, sur une variété de, des schistes métamorphiques des Alpes et sur les propriétés optiques de la zoïzite classique, 848.

TIEGHEM, Ph. v.
Sur l'organisation florale des Balanophoracees, 872.

TIRABOSCHI, C.
Contributo allo Studio della Cellula Nervosa in Alcuni Invertebrati e Specialmente negli Insetti, 845.

TRAVERS, W.
On the Origin of Gases Released by Heating Minerals and Meteorites, 942.

TREBOSCH.
Vergleichend-anatomische Untersuchungen über den Ursprung und die Phylogenese des N. accessorius Willisii, 879.

TREUB, M.
L'organe femelle et l'apogomie des Balanophora elongata Bl., 872.

TROW, A. H.
Observations on the Biology and Cytology of a New Variety of Achlya Americana, 693.

UNGER, E.
Beiträge zur Anatomie und Physiologie der Milchdrüse, 694.

VEJDOUSKY.
Bemerkungen über den Bau und Entwickelung der Bakterien, 1040.

VINCENT, S.
The Carotid Gland of Mammalia and its Relation to the Suprarenal Capsule, with some Remarks upon Internal Secretion, and the Phylogeny of the latter Organ, 1032.

VIOLA, C.
Homogenität und Aetzung, 942.

VIOLA, C., AND KRAUS, E. H.
Ueber Federowit, 1072.

VIRCHOW.
Psammona, 876.

VIVIAN, A.
A Comparison of Reagents for Milk Proteids, with some notes on the Kjeldahl Method for Nitrogen Determinations, 812.

VOGL, A. E.
Die wichtigsten vegetabilischen Nahrungs und Genussmittel, 760.

VON BRUNN.
Alkoholdämpfe als Disinfektionsmittel, 1069.

WAGER, H.
The Sexuality of Fungi, 804.

WALKER, E. L.
A Comparative Study of the So-called Polychromatophilous Degeneration of Red Corpuscles, 765.

WALLERANT, F.
Methode de détermination rapide des feldspars des rockes, 881.

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